ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XLIV. No. 17.

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PLANS FOR THE SEWERAGE AND PAVING of Havana, Cuba, as prepared by the department of engineering of that city, have been accepted by the Ayuntamiento, or city council, and that body has decided to advertise for bids for construction. The contract is to be let under old Spanish laws, the right of tanteo being reserved to Mr. Michael J. Dady, of Brooklyn, on account of some dealings which he had with the city before American intervention in Cuba. This right of tanteo gives Mr. Dady the privilege of taking the contract at the price named by the lowest bidder.

A TOTAL OF $12,531,000 for the portion of the Boston water-works taken by the Metropolitan Water Board will be paid to the city of Boston by the state, as a result of a recent settlement between the two parties in interest. Of this sum, $5,000,000 has already been paid to the city. The balance will draw 3½% interest after Nov. 1, 1900. This action settles the litigation in progress to settle the claims of the city. About 82% of the total, it is said, really falls upon the city, since the cost of the works to supply the Metropolitan District is to be proportioned among the communities benefited, in order to provide money to meet interest and sinking fund charges on the bonds issued by the state.

BIDS FOR THE 48-IN. CAST-IRON WATER MAIN between Millburn and Spring Creek, for the Brooklyn water supply, will be opened on Nov. 1 by Mr. Wm. R. Dalton, Commissioner of Water Supply, New York city. The contract will include both material and labor. The appropriation is $1,010,000. The work must be completed in 18 months.

THE IMPROVEMENT OF SAVANNAH HARBOR so as to secure a 28-ft. channel from Savannah to the sea is to be reported upon by a special board of army engineers composed of Capt. C. E. Gillette, Col. P. C. Hains and Capt. A. C. Sanford.

THE DREDGING OF THE 30-FT. CHANNEL in the Delaware River is not progressing fast enough to please the Philadelphia shipping interests. This work of dredging is now in progress at Reedy Island, 45.5 miles below the city. At this point a bulkhead is being built, 11,750 ft. long, and a channel 30 ft. deep and 600 ft. wide is to be dredged and the material deposited behind the bulkhead. The contract calls for the digging of 13,000 lin. yds. of channel and the removal of 2,000,000 cu. ft. of mud by Jan. 1, 1901. President C. S. Griscom, of the International Navigation Co., writes to the Trades' League and estimates that by that date only half this work will be done. The government engineers have a $500,000 appropriation available; but they claim that with a continuous contract and $5,500,000 they could dredge this 30-ft. channel 600 ft. wide in five years. The present contract expires on Oct. 1, 1901, and calls for the removal of 4,200,000 cu. yds. of mud by that time, under penalty of receiving only two-thirds price for the work performed.

THE STETTIN-SWINEMUNDE CANAL, with a length of about 35 miles, has been dredged throughout and is now open to steamers drawing 22 ft. of water. Swinemunde is on the Baltic Sea.

THE HARBOR OF TRIESTE, Austria, is to be enlarged under a contract just signed by the Austrian government. The present harbor only admits vessels of 300 tons to the wharves, though vessels of any size may safely anchor at a short distance away from them. The imports of Trieste are valued at $70,000,000, and its exports at $50,000,000 per annum.

THE PROPOSED SOUTHAMPTON-LONDON SHIP-canal, which is referred to in recent Associated Press dispatches would seem to be a rumor without other foundation than the vivid imagination of some reporter. No details are given, other than that Mr. Charles T. Yerkes is "possibly" behind the enterprise. A glance at the country lying between London and Southampton will be sufficient to dampen the enthusiasm of any proposing investor in ship-canal stock on that route. The advantage of such a canal, as set forth, is that "it would land transatlantic passengers in the heart of London, many hours earlier than by any other route." But several steamship lines now land their passengers in the Thames, and the special London-Southampton railway trains provide a quicker service than would be possible on any ship canal.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Chicago & Alton Ry. at Lincoln, Ill., on Oct. 16. A repair gang had removed several rails and the engineman of a fast freight failed to see the flagman in time to stop his train. Three men were killed and two injured and 17 cars were wrecked.

BY AN ACCIDENT in the new Paris underground railway, on Oct. 19, 29 persons were injured, two being fatally hurt. The accident occurred near the Exposition grounds. A train entered the station at the Place de la Concorde and backed out again, and a following train ran into it owing to misunderstood signals. Both trains were fortunately moving slowly, but the end of the rear car was smashed, the windows of both trains were shattered and the electric lights were extinguished. Traffic was suspended for several hours.

SLIDES OF THE RIVER BANK of the Mississippi, just above New Orleans, La., have caused considerable damage to the Southport property of the Illinois Central R. R. There are two elevators and a wharf, a portion of the latter being covered, and these are located in an abrupt bend of the river, which was only partially protected by mattress work and revetment built under the direction of the U. S. Engineers. For several seasons there has been trouble at the upper end of this mattress work, slides in the bottom of the river carrying out portions of the wharf. This season, the amount of wharf destroyed is very much larger than ever before, and it has been practically decided not to rebuild it again. The cutting action of the river may extend to the site of the elevators, but this is as yet uncertain. The whole matter is under consideration, and it is not yet known what action is likely to be taken.

THE RESPONSIBILITY FOR THE BOSTON gas explosion, on March 4, 1897, has been placed on the Boston Gas Co. by the full bench of the State Supreme Court of Massachusetts. The explosion, as stated in our issue of March 11, 1897, occurred at the intersection of Boylston and Tremont Sts., during the time when the new subway was under construction by the Boston Transit Commission. Two 6-in. gas mains had been exposed in excavating for this work and the excavation was covered in temporarily by a wooden roof. A car passing over this point was thrown into the air and two others were upset, besides various other casualties, resulting in the death, finally, of twelve persons and the injury of many others. It is supposed that an electric spark from the trolley car fired the gas accumulated in the space below. After many years of litigation the numerous defendants named in the early bills, which included the subway contractors, an electric lighting and a street railway company, as well as the gas company, narrowed down to the latter. There were a number of claimants at the start, also, but the present decision against the Boston Gas Co. awards $3,000 to Wolfe Koplan, a bootblack, for personal injuries, affirming the judgment of the court below. Many other suits, both for personal and property damages, are now expected, unless compromises are effected.

THE ZEPPELIN AIR-SHIP had a notably successful trial at Friederichshafen, on Lake Constance, on Oct. 17. The air-ship attained a height of nearly 2,000 ft. and there remained poised for 45 minutes. It then made a series of tacks, and described a circle of about 6 miles circumference. The wind exceeded a velocity of about 7 miles per hour, and the air-ship made headway against this wind for a considerable distance. After remaining in the air for about one hour the ship descended to the lake with great ease and was towed to its shed. In steering, stability and equilibrium the test was pronounced very successful. This air-ship—built by Count Zeppelin at a cost of about $375,000, including experiments, is cylindrical in form, is 400 ft. long and 36 ft. diameter, pointed at the ends. It contains 17 seperate balloons, and supports two gondolas beneath, placed 83 ft. from either end, each containing a 15-HP. Daimler motor operating two propellers, and the steering apparatus. The screws make 1,200 revolutions per minute. The entire weight of the air-ship is 8,800 lbs., and its inventor estimates that it could rise to a height of 3,300 ft., carrying 2,200 lbs. dead-weight and could be kept in the air for eight days. The first ascent was made last July, but a slight derangement of the steering gear caused a sudden descent into the lake.

FORESTRY EXPERIMENTS in California are being conducted by the Arrow Head Irrigation Co. of California. The purpose of the experiments is to determine as precisely as possible the value of timber to a watershed. The company's lands include all manner of forest land, heavy and light, old and new growth, and burnt-over and denuded forest tracts. The rainfall on all these lands is accurately measured, and the relative amount of run-off is carefully estimated. As the experiments are being conducted on an extensive scale, results of great value are expected.

THE HIGHEST TEMPERATURE RECORDED at Paris, says the director of the Chateaudun observatory, was 103.6° F., on July 27, 1900. The highest previous record was 101.5°, on July 20, 1900. In 1870 a record of 106.2° F. was made at Poitiers. In England a record of 95.2° F. was recorded at London, on July 6, 1900. In July, 1881, the Greenwich Observatory recorded a temperature of 97.1° F.

THE REPORT OF THE U. S. Bureau of Construction and Repair for the fiscal year 1899-1900, is the last one to be made by Rear Admiral Hichborn, who retires on March 4, next. The principal items in the estimates submitted are: Preservation and repair of vessels, $7,000,000; repairs and improvements at navy yards, $920,000, and hulls, outfits and steam machinery of vessels authorized, $21,772,917. The need of additional dry docks is forcibly pointed out, as but nine government dry-docks of all sizes are available in seven different ports; and of these but one is large enough to take the battleships. In contrast, Great Britain has 52 such docks in eight home ports; and France has 35 docks in five home ports; and both countries have in addition a number of private dry-docks that could be used in an emergency. Admiral Hichborn advocates the building of some of the warships at the government yards, and says that this is necessary for the training and efficiency of the navy yard staff that is essential to our naval organization. He also approves of the Holland type of submarine boat, and believes that it is an efficient and comparatively inexpensive but formidable instrument of war.

THE FRENCH LOCOMOTIVE described and illustrated in our issue of Oct. 18, has been made the subject of the September Bulletin of the French Society of Civil Engineers, the author being M. L. Prevost, Engineer of the works of Schneider & Co. Besides the matter presented in the article above referred to, he gives the results of tests made on the French State railway between Chartres and Thouars. In the first set of tests, made independently of the management of the road, a speed of 73 miles per hour was obtained in the level stretch of road lying between Chateau-du-Loir and Pont-de-Bray. The train consisting in all of 16 coaches, weighed 186 tons. Steam was admitted to the cylinders during 18% of the stroke when running on the level. In the second set of tests the speed was limited to 56 miles per hour except on the section from Chateau-la-Valliere to Noyant-Meon, where a speed of 62 miles was permitted. Between these places a speed of over 62 miles was obtained on a level stretch with an admission to the cylinders of 15%, the train weighing 208 tons. This train was hauled up a 1% grade at about 50 miles per hour with an admission of 35%. In all the trials no difficulty was found in maintaining a steam pressure of 213 lbs. without forcing the fire. Unfortunately these tests were made under conditions other than those for which the machine was designed. It was intended solely for making long runs on lines where the grades were not in excess of 0.5% and curves of at least 1,000 ft. radius. The state railway, however, between Chartres and Thouars presents a series of grades between 1 and 1.4% and curves of 1,600 ft. are frequent and there are some of 900 ft. It would be imprudent to run at 75 miles per hour on such curves and the adhesion of the locomotive is not sufficient to permit grades of 1% and over being ascended at high speeds.

THE BIRMINGHAM, ALA., iron and coal industry is reported upon by the Birmingham Commercial Club. The estimates for 1900, as compared with the output for 1899, are as follows:

	1899. Tons.	1900. Tons.
Coal mined.....	7,484,773	8,750,000
Coke production.....	1,798,612	2,050,000
Iron-ore production	2,627,000	3,000,000
Pig-iron production	1,083,905	1,200,000

A PASSENGER LOCOMOTIVE WITH A SUPERHEATER; PRUSSIAN STATE RAILWAYS.

A novelty of particular interest in locomotive construction, which appeared among the railway exhibits at the Paris Exposition, was a passenger locomotive designed for the use of superheated steam. This locomotive was built by Mr. A. Borsig for the Prussian State railways and is stated to be the third locomotive equipped with a superheater, to be built in Germany. The present design is said to have been evolved from the practical experience gained with the others, and although it has not been tested in actual operation the builder confidently expects to secure a material increase in economy over ordinary locomotives of the same type, but without superheaters. The illustrations, Figs. 1, 2 and 3, and the following description of the new engine are taken from the London "Engineer" of Sept. 7, 1900. Fig. 4 is a general view of the engine reproduced from London "Engineering."

The engine is a twin-cylinder express, single-expansion, with cranks at 90°, and two axles coupled. Figs. 1, 2 and 3 show the construction in detail. Fig. 1 is a section through the smoke-box and the superheater looking backwards. Fig. 2 is a sectional plan of the smoke-box and superheater, the section being taken near the top of the barrel. Fig. 3 is an outside view of the smoke-box and superheater looking backward, and with the front door removed.

There are two driving axles coupled and a four-wheeled bogie. The drivers are 6 ft. 6 ins. in diameter, and their axles 8 ft. 6½ ins. apart. The wheel base of the bogie is 7 ft. 2½ ins., and the distance from front driver to rear bogie wheel is 8 ft. 6½ ins.; the total wheel base is 24 ft. 3½ ins. The leading wheels are 3 ft. 3¼ ins. diameter. The gage is 4 ft. 8½ ins. There are two outside cylinders 20 ins. diameter by 24 ins. stroke. The working pressure is 170 lbs., and the heating surface, exclusive of superheating tubes, 1,167 sq. ft. The grate surface is 24½ sq. ft. The superheating surface is 301 sq. ft., being thus just over a quarter of the ordinary steaming surface. Empty, the locomotive weighs 51 tons and about 56 tons in running trim. About 31 tons comes upon the driving wheels.

The fire-box is of ordinary construction; in fact, the locomotive is throughout of the standard Prussian State Railways pattern for two-cylinder expresses, except in so far as it has been modified to introduce the superheater.

The leading principle of this superheater is that its heating surface is traversed by a portion of the furnace gases fresh from the furnace, which has not been cooled by traversing any of the ordinary steaming surface. As the superheater is placed in the smoke-box, a free passage from the fire-box is provided in the shape of a tube A, 10 ins. in diameter, running along the bottom of the barrel

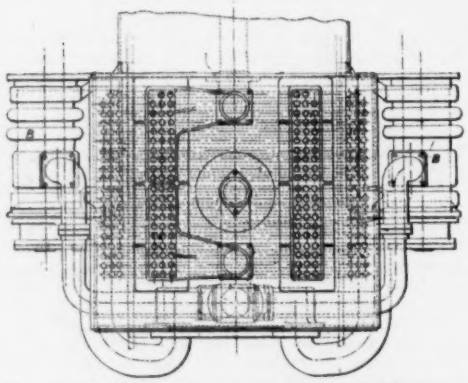

Fig. 2.—Sectional Plan of Smoke-Box and Superheater; Borsig Locomotive, Prussian State Railways.

and displacing a certain number of the ordinary fire tubes. The surface of this tube acts as steaming surface, because the tube runs through the water space; but the way is so free that the hot gases give up comparatively little of their heat in traversing it. The tube discharges into the base of the smoke-box, and a prolongation of it is formed throughout the length of the smoke-box by the arching upwards of the bottom part of a steel-plate lining inserted in the smoke-box. The smoke-box, which is 5 ft. 1 in. long, has an outside shell of 5 ft. 7 ins. inside diameter, and an extra inside shell or lining of 4 ft. 4 ins. diameter. The radial thickness between these is thus 189 mm. (7½ ins.) The space between them forms the superheating chamber. The upper edges of the inner lining turn upwards to meet the outer shell at a distance of 3 ft. 9 ins. apart, thus forming a gap through which the chimney passes. This gap is rectangular in plan, and along its two longitudinal edges are placed on top of the shell two steam boxes C C, Fig. 1, each of rectangular cross section. In the sides of the gap formed by the top edges of the inner lining there are a number of port holes covered by flap valves. These flaps are geared together, and are closed or more or less opened at will from the driving platform by a suitable linkage. When closed the circulation of furnace gas through the superheating chamber is stopped, and it can be regulated as desired by opening them more or less. Without moving the flaps, also, there is in a certain degree an automatic regulation of the flame-draft through the superheater, because this draft depends on the vacuum at the chimney base in the smoke-box, and this vacuum is greater the

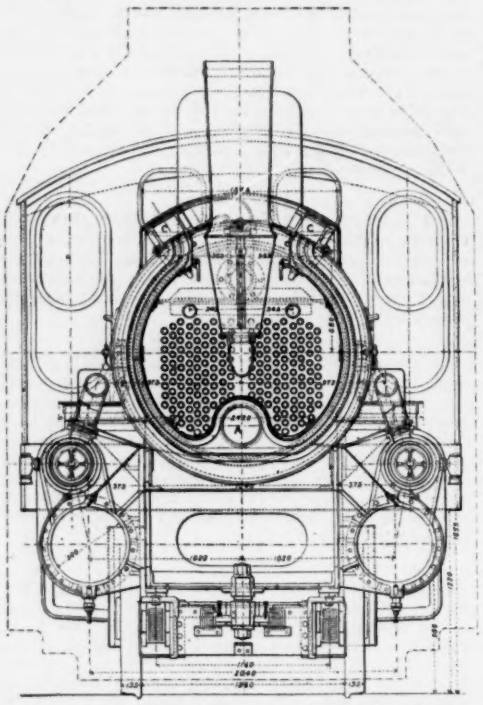

Fig. 1.—Transverse Section Through Superheater and Smoke-Box Looking Backwards; Borsig Locomotive, Prussian State Railways.

more horse-power is being developed in the cylinders and the greater the exhaust discharge at the blast nozzle. On the other hand, in order to preserve the tubes of the superheater from overheating and burning, when the variable exhaust is closed, the above flap valves are closed, the two being so linked together as to prevent the driver using the high-pressure blast and the superheater at the same time.

The superheating chamber between the inner and outer smoke-box shells is filled by a nest of 60 tubes of 1½ ins. outside diameter. These are ranged in three cylindric sets, each tube being bent in the cross sectional plane so as to form a ring with a gap at top. The two top ends of each tube are riveted into the two steam boxes lying right and left of the chimney. The inner cylindric set of 20 tubes is at the bottom bent upwards, so as to arch over at A, Fig. 1, the inflowing stream of furnace gas. The outer two sets of tubes, 40 in all, pass underneath this inflowing stream. The hot gases find their escape only by the flap valves at the top of the superheater, so that they are forced to travel over this nest of tubes. The steam-box to the right hand of the stack is divided into a hinder and a forward section by a transverse diaphragm.

The steam from the boiler enters the hinder division, and from it travels downwards through 30 of the superheated tubes, rising again in these on the left-hand side of the smoke-box, and being discharged from them into the left-hand steam-box. This box has no transverse diaphragm, so that it permits the steam to pass forwards from the first 30 tubes into the remaining 30. It descends these latter on the left-hand, thus traversing the whole circle of the superheating chamber a second time, and, rising on the right-hand of the stack, it is discharged into the forward division of the right-hand steam-box. From this it is lead by a branched pipe, Fig. 3, to the two cylinder valve chests B B, Fig. 2.

This superheater is said to be capable of bringing 12-atmosphere steam up to a temperature of 626° F., the hot gases being estimated to be cooled about 1,470° F., in passing through the superheater. No more than 300° C. temperature is ordinarily employed. The valves are pistons admitting on their inner edges. The valve chest is kept well separate from the cylinder, as is seen in Fig. 1; and in order to avoid its being overheated, its wall is deeply corrugated, this corrugation also giving it some freedom of expansion independent of the cylinder.

The cylinder piston has three rings. One of these is a broad stiff ring, which is pressed outwards, or rather downwards, by internal springs off the lower half circumference of the piston only. The function of this ring is to carry the weight of the piston; it is not supposed to act as a packing ring. On each side of it is inserted a light packing ring of ordinary pattern. By this device the packing rings are enabled to press against the cylinder walls with equal intensity of pressure all round the circumference—a result which it is evidently impossible to obtain if the springs of the packing rings are used to transmit the weight of the piston to the lower side of the cylinder wall. The piston-rods pass through stuffing boxes packed with metal rings only.

THE RECENT WATER FAMINE IN PARIS; WATER WASTE AND PURIFICATION.*

The summer of 1900 has been remarkable for a prolonged series of days of excessive heat in July, which have in many places increased largely the consumption of water. Many water-works systems have been thus put to a rude proof, and some of them have found the situation difficult. It is with profound astonishment that one has seen the service of water in Paris, commencing with July 21, interrupted from 11 p. m. until 6 a. m., the reason given being that the service of potable water was in danger of being exhausted because of the increased consumption, and that a large number of takers allowed their faucets to run constantly to secure cooler water. This practice is stated to occur most generally at night, and explains the fact that there was a large increase in the night consumption. The custom of supply during the 24 hours has come to be regarded as a right, and those making use of it were subject to a rude awakening.

It should be admitted at once that the officials responsible would not take such a radical measure unless forced to it. But one may fairly ask if the reasons announced are valid, and for the real cause of the conditions which seemed to make such a course advisable.

The "Revue Industrielle" of Paris makes the observation that the whole of the domestic consumption is metered, and that if people draw water continuously, it should show itself in an increase in the receipts. If this is so it will only be known at the end of the quarter when the meters are read, and it seems premature to attack now the official allegations. The attendance of strangers at the Exposition would readily account for an increase in the consumption.

But there have been years before when the situation at Paris has presented an anomaly, or, more exactly, a series of them. The engineers take pains in their annual reports to mention the quantities of water from the various sources brought to Paris and their distribution between the public service and private service. It is thus stated that for the year 1897 there were furnished 201,165,000 cu. m. (53,107,560,000 U. S. gallons), or a daily

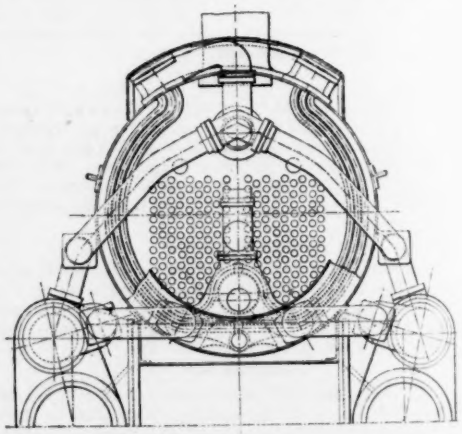

Fig. 3.—Front Elevation of Smoke-Box and Superheater; Borsig Locomotive, Prussian State Railways.

quantity of 551,000 cu. m. (145,464,000 gallons), divided as follows:

	For the year		Daily	
	Cu. m.	Gallons.	Cu. m.	Gallons.
Spring waters.	85,264,000	22,500,000,000	233,500	61,644,000
Arcueil wells..	2,431,000	641,000,000	6,700	1,768,000
River water...	64,287,000	17,000,000,000	176,000	46,464,000
Ourcq canal...	49,183,000	13,000,000,000	134,800	35,587,000

According to the same authority these were employed: (1) For private services, 68,656,000 cu. m. (18,125,000,000 gallons) of spring water; 44,530,000 cu. m. (1,175,000,000 gallons) river water; (2) For the public service, 87,979,000 cu. m. (23,226,000,000 gallons) of water from various sources, river, canal, wells and even spring water. This was for a population of 2,530,000, or for each inhabitant,

*Abstracted by Allen Hazen, M. Am. Soc. C. E., 220 Broadway, New York city, from an article in the "Technologie Sanitaire" for Sept. 1, 1900, written by Mr. Adolph Kemna, of the Antwerp Water-Works.

122 liters (32 gallons) for private service, and 94 liters (25 gallons) for public service. (A total of 57 gallons per capita per day.—Ed.)

So much for the official data. Now let us pass to some deductions. The city does not sell the water itself. There is an intermediary, the Compagnie General des Eaux, which deals with the public, makes contracts and operates the services. On Dec. 31, 1897, it had 83,720 takers, distributed as follows, according to the nature of the water:

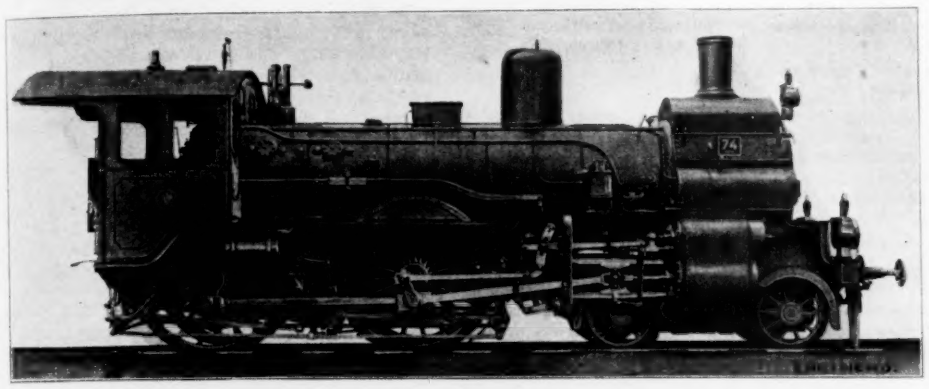

FIG. 4.—PASSENGER LOCOMOTIVE WITH A SUPERHEATER; PRUSSIAN STATE RAILWAYS.
A. Borsig, Berlin, Germany, Builder.

	Spring water.	River water.	Canal water.
By meter, tariff of 1880	5	6,318	5,150
" " 0.35 fr. per cu. m. (25.6 cts per 1,000 galls.)	69,155	...	...
" " 0.60 fr. per cu. m. (44 cts. 1,000 galls.)	1,493	...	...
" " 0.17 fr. per cu. m. (12.4 cts. per 1,000 galls.)	229	...	...
" " special contract	74	...	...
Services estimated	...	572	185
Free faucets	...	22	22
Total takers	70,956	7,407	5,357

The receipts from these takers by the Compagnie General des Eaux were as follows:

For spring water	11,590,504 fr. or	$2,236,967
For river water, etc.	3,269,726 fr. or	631,057

If we apply to the first figure the price of 0.35 fr. per cu. m., it represents a consumption of 33,115,726 cu. m. (8,742,000,000 gallons), and the total quantity of spring water delivered in Paris may then be classified as follows:

	Cubic meters.	Gallons.
Total spring water	85,264,000	22,509,000,000
Employed in the public service	16,608,000 (20%)	4,384,000,000
Paid for by takers	33,115,726 (39%)	8,742,000,000
Not accounted for	35,540,274 (41%)	9,382,000,000

It is true that in the receipts of the company no account is taken of the water used in municipal establishments, nor in certain non-municipal public establishments, nor by the people dwelling in houses owned by the city. The total value of this consumption is estimated to be worth 1,725,000 fr. ($333,000), representing a maximum of 5,000,000 cu. m. (1,320,000,000 gallons). If we take this into account there remains still 30,000,000 cu. m. (7,920,000,000 gallons) (35%) of spring water that passes no one knows where.

The first idea that suggests itself is that there are leaks in distribution. The quantity of water lost is enormous, but on the other hand the piping system is greatly extended, lines of large pipe extending for many kilometers. Then we have the formal declaration of the water department that the most serious attention has been given to this, and without results. The administration is convinced of the perfect tightness of the pipes.

The deficit may be explained in another way, by the under-registration of meters. It is said that the proportion of meters examined and requiring considerable repairs amounts to one-third of the total number of meters examined. In 1897, 18,049 domestic meters were examined, or one-fourth of the total number. One-third of this number were defective. This would place the life of a meter at about ten years.

There are many examples of cities where the meters have only effected a temporary reduction in the consumption. At the end of a few years the quantity of water pumped is increased, the quantity registered diminished, and the pumpage becomes more regular. The diminution of consumption at night becomes less marked. The little steady losses, the minute streams of water that run always, are only very imperfectly registered. With certain kinds of meters it is possible to obtain with water at 35 centimes per cu. m., 500 fr. ($97) worth without charge, but this kind of meter is rigorously excluded at Paris. The engineers have a severity which many people regard as exaggerated, but which is perfectly justifiable. They only admit meters of the very first quality, notwithstanding the higher price. But in spite of these precautions, there are still losses that are inevitable. In certain cases the losses may represent three-fourths of the amount consumed, but with regular inspection such a case could not be otherwise than exceptional. It seems extremely difficult to admit this cause as the explanation of the deficit.

But whatever may be the real cause, the suppression of this loss would render possible the utilization of the deficit. One would then have spring water in quantity more than sufficient for all domestic needs, and it would be unnecessary to go to the enormous expense of bringing spring waters from the more and more distant places, and of doubtful quality. The "Revue Industrielle" draws this conclusion from the figures given above, and adds from the pen of M. Delahaye the following remarks:

It is true that hunting up the leaks in a system of distribution and the systematic control of meters are not classed among the works which in the present system of rewards are considered "services exceptional." The engineer advances most rapidly when his bridges break under him. During the war of 1870 there was a captain of artillery who was promoted to chief of a squadron because he was only able to escape with the smallest part of his battery. It seems much the same with irresponsible engineers of states and cities: The grand conceptions, the adventurous works, are for them the source of much profit. Failure even in such works opens to them a career, and gives them more notoriety than the regular accomplishment of current necessities. They like in general much better to go to the base of Mont Blanc to find water, than to make use of that which they allow men to waste. Moreover, operations of this class are pleasing to contractors, and there are those people who consider that there is an advantage in giving employment to workmen; yes, to many workmen, and even to hold them at a distance from the cities. All conspire then, without mentioning the financiers, to make the municipalities resort to more and more solutions of which the sole merit is that they cost dearly.

There is in this same article an erroneous reasoning. The author cites the case of Stratford, England, where one has been able to reduce the consumption by 60%, and he transports this percentage to Paris, showing the amount of water which can be saved, but he overlooks the fact that Paris is metered throughout, and that if water is wasted in detail it should show itself in increased receipts.

One figure that commands our attention is the quantity of spring water that is used for public services. Sixteen million cubic meters (4,300,000,000 gallons) or 20% of the total, and also a little more than 20% of all the water used in the public service. This is the best proof of the impossibility of the double service. One refuses to employ the precious spring water for the coarser uses of the street, and one takes the river waters; but there is objection to the enormous expense of the installation necessary to the use of river water in general, the pressure given is insufficient to reach the highest places, or to serve for the public fountains, for elevators, etc. Even if the public service could be entirely served with river water, there is still much waste, for the grosser domestic uses must still be served with spring water, such as the use for water closets, gardens, etc. This could only be avoided by a double system of pipes, not only in the streets, but in each dwelling, with separate meters, delivering water at different prices, and efficient measures to prevent the consumption of river water for those uses for which it is unsuitable, but to which the lower price would incite.

But that is not all. There is still another point, the importance of which is demonstrated by the experience of Paris. That is the possibility of supplementing the deficiency in the spring water by mixing with it river water. This has been the practice until quite recently in the city which glorifies itself to have possessed Pasteur. During each year for some weeks it was necessary to resort to this measure. To reduce the dangers, and to avoid the mixture of water which would contaminate the whole system, the river water was used in one quarter of the city only, the inhabitants having been duly warned and the spring water being maintained in certain public fountains. These precautions were the best that could be taken, but the public easily found ways to avoid them. The insufficiency of the measure was further demonstrated by the occurrence of typhoid fever, observed in those quarters about three weeks after the introduction of river water. The municipal council decided one day to supply the river water exclusively to the more wealthy quarters of the city, and to reserve systematically the spring waters for those parts in which the laborers mostly lived. The ultra-socialistic tendencies of this council are probably well known, and this was probably inspired by a sentiment of hate against the more fortunate classes. Unfortunately it was perfectly justified, from a hygienic point of view. In the better houses there were servants who were able to boil the water before using it, or even its place was taken entirely with table waters, a procedure totally unrealizable among the working classes.

This contamination of the drinking water by those charged with maintaining its purity sometimes resulted in positions which would be most comical were they not so deeply to be regretted. In 1890 the sale of ice was regulated, and it was ordered that any ice which upon melting failed to give a good water could not be sold under the name of domestic ice. Takers were required to have two ice boxes, without communication between them, for the two kinds of ice. The wagons carrying the inferior ice had to be of a special color to make their character apparent. All this is very nice; but the maker of ice who used the drinking water of the city was forbidden to sell the product as domestic ice. It was necessary for him to distill the water or subject it to some other purification.

At the session of Sept. 15, 1899, of the Council of Public Hygiene of the Department of the Seine, the engineers of the water department made a communication important from at least two points of view. At first it was declared that notwithstanding the dryness of the summer, about completed, which had forced the consumption as high as 738,000 cu. m. (194,832,000 gallons) of water per day, not a drop of river water had been sent into the domestic service pipes. So much for the past. For that which concerned the future, the year 1900, and the Exposition, the declarations were not less formal and optimistic. The thousands of cubic meters of water available daily for Paris were reviewed complacently; Dhuys 20,000 cu. m. (5,280,000 gallons); Vanne 120,000 (31,680,000 gallons); Avre 100,000 (26,400,000 gallons; Loing and Lunain 50,000 (13,200,000 gallons) and more than 50,000 (13,200,000 gallons) of filtered river water, or altogether a total of 340,000 cu. m. (89,760,000 gallons); and finally was mentioned the quantity of 600,000 cu. m. (158,000,000 gallons) of storage capacity which would be available to balance the fluctuations in consumption.

An engineer in the water business must never praise himself or he will regret it. Something is certain to happen. I have seen many examples, some of the most serious of which have happened at my expense. I thus understand how to sympathize with the responsible gentlemen at Paris. But they are justified in not using the river water more extensively. The interruption of the water supply during the night is a serious inconvenience and very apparent. The use of the river water is not an inconvenience. It is a danger—a danger more serious and less apparent. There is evidently someone who has had the choice between these two alternatives, and who has had the courage to choose the measure which would excite the public and put everyone against him. This man deserves well not only of Paris, but of France and of all the strangers who have attended the Exposition; that is to say, the representatives of all humanity.

Another important fact is the recognition of the practicability of sand filtration. Filtered Seine water already enters in considerable measure into the supply of Paris. The objections so obstinately opposed to this procedure are being finally disposed of by the evidence of facts, and in future nothing will prevent the development of the necessary installations. With only a small part of the millions which would be spent in securing spring water one is able to build many filters.

It is always a dangerous matter to give advice where it has not been asked. In the presence of the actual situation it was given out in 1899 that there were 4,300 deaths from typhoid fever (1,618 per 1,000,000 inhabitants living, a figure which had not been attained since 1892). It would seem that there is good reason to make a profound inquiry as to the conditions. When the water administration acquires the courage to take the bull by the horns, a commission of five competent and impartial men could be appointed to investigate all public documents, hold public sessions, and hear from those who have anything to say; and it might be found that some errors have been made, notably with the springs of the Avre.

Error is human, but as a result it will be found that engineers have built many beautiful and fine things. These will be conserved, others will be modified, and in the end much recrimination and misery will be done away with. Of such miseries and difficulties Paris has no monopoly. There is a wide circle of those who suffer equally from their water problems.

PUBLIC WORKS IN HAVANA, executed under the Engineer Division of the Havana Department, have cost $3,062,517 up to April 30, 1900. Almost the whole of this sum was expended in repairing, renewing and improving the public property in Havana.

THE NEW 750-FT. DRY-DOCK OF THE SAN FRANCISCO DRY-DOCK CO., AT HUNTER'S POINT, CAL.

(With two-page plate.)

A notable addition to the dry-dock facilities of the Pacific coast is planned by the San Francisco Dry Dock Co. at its yards at Hunters' Point, San Francisco, Cal. The new dock for which plans have been prepared and the bids for construction asked will be 750 ft. long, 122 ft. wide at the coping, and 74 ft. wide at the bottom, and will have a depth at the entrance of 32½ ft. below the coping and 28 ft. below high water level. As will be observed from these dimensions the dock will be one of the largest and most commodious in the world. Compared with the new masonry dry docks which are to be built by the United States Government the corresponding main dimensions are as follows:

Dimensions.	Government. ft.	ins.	California. ft.	ins.
Length on coping	750	..	750	..
Width on coping	144	6	122	..
Width on floor	80	..	74	..
Depth of floor below coping	39	3	35	10

The plans for the new Hunters' Point dock have been prepared by Mr. Howard C. Holmes, Chief Engineer, State Harbor Commissioners, San Francisco, Cal., and we are indebted to this gentleman for the drawings and information from which the following description is prepared:

The general plan of the new dock and its appurtenances and its location in relation to the existing dry dock, wharves and water lines, are shown by Fig. 1. It is located south of the present dock, with its axis veering at an angle of about 14° from the axis of the old dock. Like the old dock, it will be excavated in the solid rock of the little peninsula which forms the property of the company. This rock is green serpentine, impervious to the water and easily excavated. This rock is to be excavated to lines corresponding closely to the contours of the dock chamber so that only a thin lining of concrete is necessary to finish the chamber. For the outer end portion of the dock, where the bedrock dips under the water surface, the walls must be extended to the required height by concrete masonry side walls. These concrete side walls are to be anchored to the bedrock by means of sections of railway rails used as holding down bolts and set every 10 ft. apart.

Referring particularly to the dock chamber construction, the entire chamber will be concrete lined except for the sides of the approach, the seat for the caisson and the apron arch, which will be of cut granite masonry. Fig. 2 shows a half-transverse section at the caisson seat and a half-transverse section in the body, and illustrates in connection with Fig. 1 the extent and general character of the concrete and the granite masonry work. There are to be 16 alters on each side of the chamber extending from a point 100 ft. from the gate seat to a point within 150 ft. of the head of the chamber. The bottom of the chamber will have a timber flooring embedded in concrete to support the keelson, bilge ways and bilge blocks.

The concrete side wall lining begins at a point at least 1 ft. below the surface of the rock bottom, and is carried up along the sides as shown. Molds are to be used to give the proper form and dimensions to the lining, and the concrete is to be rammed into these molds in 6-in. layers. Between the concrete lining and the rock surface there is to be a waterproof coating consisting first of a coat of refined asphaltum reduced in benzine and sprayed on, and then of two coats of asphaltum applied hot. The location of the alters, eleven at the top and five at the bottom on each side, is shown by Fig. 2, and their dimensions are shown by Figs. 3 and 3a. The entire surface of the concrete lining is to be plastered with a ½-in. coat of one cement and one sand mortar floated and troweled to a hard, smooth surface. All concrete veneers will be additionally strengthened against checking with an interstitial web of expanded metal.

In building the floor the rock bottom of the dock chamber is to be cleaned and recessed for the sill or bilge way timbers. These sills are to be 12 × 12-in. Douglass fir timbers laid transversely across the dock 10 ft. apart and recessed 6 ins. into the rock bottom, to which they are to be fastened by 7 ft. × 1⅛ in. anchor bolts spaced 7 ft. apart. Running longitudinally of the dock between the sills there are to be 6 × 6-in. stringers spaced 8 ft. apart and toe-spiked flush with the tops of the sills. The space between the sills and stringers is to be filled flush with concrete. The keelson extending longitudinally along the center line of the dock is to consist of four 12 × 12-in. yellow fir timbers screw bolted together and anchor bolted to the rock bottom. The flooring is to consist of 4 × 12-in. yellow fir planking boat spiked to the stringers for the spaces between sills and of 4 × 18-in. Port Orford cedar plank or bilge ways for the spaces over the sills. These bilge ways will be boat spiked to the sills and have iron guides for the bilge blocks, which are to be of laurel. On each side of the wooden flooring and at the feet of the side walls there will be a gutter built of concrete and surfaced like the side walls. Each bilge block is provided with an eye bolt, and directly opposite in the side walls are pulley blocks, these attachments being provided for the rope used in hauling the bilge blocks to one side. Belaying pins and locating pins are set into the concrete of the curb and the tread of the first steps below. These various details are shown quite clearly by Figs. 3 and 3a.

The concrete used for the lining is to be composed of 18 cu. ft. broken stone, 4 cu. ft. of sand and 1 barrel of Portland cement, and that for the large walls of 20 cu. ft. of broken stone, 5 cu. ft. of sand and 1 barrel of Portland cement. The specifications require the mixing to be done as follows:

The crushed rock must first be spread on a wooden platform in layers not to exceed 6 ins. in thickness; over this will then be spread first the sand and then the cement, each in its proper proportion; the bed thus formed must be turned with shovels three times while dry and once after being wet, but under no circumstances will a so-called patent or machine mixer be allowed to be used.

The stone masonry is to be of first-class granite ashlar work.

The drainage of the dock chamber is to be accomplished by means of the side drains leading to a sump which drains into the pump pit. It will be noticed from Fig. 1 that one pump pit drains both the new and the old dock. The suction tunnel connecting both docks with the pump pit is circular in section, 8 ft. in diameter, and is built of brick lined with an asphaltum coating of the composition previously described for waterproofing the side walls. The sump in the new dock will be 8 × 20 ft. × 10 ft. deep, and built of concrete. The pump pit construction will be described further on. The location of the suction tunnel relative to the discharge tunnel is shown in plan by Fig. 1 and in elevation by Fig. 4. This discharge tunnel will be of the same dimensions and is to built in the same way as the suction tunnel. Its principal structural details

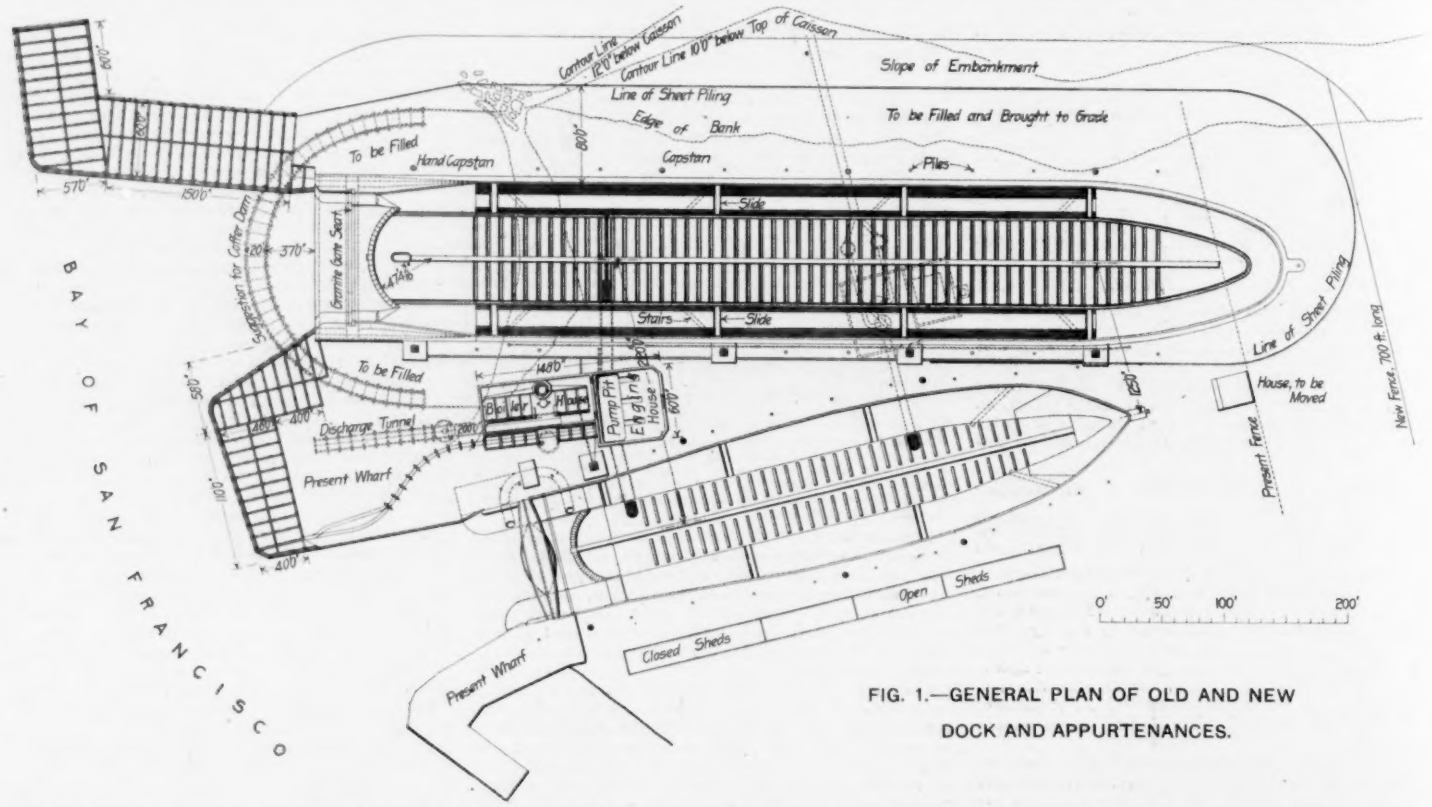

FIG. 1.—GENERAL PLAN OF OLD AND NEW DOCK AND APPURTENANCES.

are shown by Fig. 4. The entrances of the suction tunnel into the pump pit are closed by hydraulic gate valves; details of one of these valves are shown by Fig. 5.

The entrance of the dock is closed in the usual manner by a steel caisson, the general details of which are shown by Fig. 6. This caisson is 104 ft. 8 7-16 ins. long, with a molded breadth of 22 ft. and a depth of 33 ft. 9 ins. from bottom of keel to the under side of the upper deck. The general nature of the structural steel work of the caisson is quite fully shown by the drawings and need not be described further. Both basic and acid open-hearth steel will be used with the following general physical requirements:

Character.	Phos. %	Sulph. %	Tens. Str. Max. lbs.	Elong. %	Reduc. %
Basic steel.....	0.05	0.04	65,000	25	45
Acid steel.....	0.07	0.05	70,000	22	40

The caisson is reversible and is divided into six watertight compartments. The dock is filled through the caisson by means of thirteen 30-in. gate valves, the locations of which are clearly shown by the side elevation in Fig. 6. Sea valves 6 ins. in diameter are provided for flooding the caisson, and it will be emptied by a 3,000-gallon centrifugal pump operated by an engine and boiler carried on the caisson. The usual air ports, scuppers, capstans and other appurtenances are provided.

The power plant consists of a boiler and engine house built of brick and respectively 40 × 90 ft. and 50 × 60 ft. in plan. The boiler room has plastered walls and a concrete floor, and the engine room has walls, floor, ceiling and roof timbers of Oregon pine with natural wood finish. Along one front of the boiler house there is a row of coal bunkers constructed as shown by Fig. 7. The general arrangement of the engine and pumping plant is shown by Fig. 8, and this drawing with the following extracts from the specifications explain the nature and arrangement of the machinery:

BOILERS.—There are to be seven water-tube boilers; six of 200 HP. each set in three batteries of two each and one 75 HP., one feed water heater, two duplex feed pumps. The boilers are to be connected with brick smokestack. Each boiler to be not less than 200 nominal horse power (one horse power equals 30 lbs. of water evaporated from 09° F. to steam at 70 lbs. pressure) and to have not less than 2,000 sq. ft. of heating surface (1,800 sq. ft. to be in tubes between headers) and 40 sq. ft. of grate surface. They are to be of the inclined straight water-tube type; to be set in brick work so as to provide for the expansion and contraction of the metal parts or brick work independent of each other, and manholes, handholes, and cleaning-out doors to be provided so as to afford easy access to all parts of the boiler for cleaning and repair purposes. They must be designed for a working pressure of 125 lbs. per sq. in., and are to be tested and made tight under a hydrostatic pressure of 240 lbs. per sq. in. after erection. The boiler to be fitted with nickel seated safety valves, nickel plate steam gages with 12-in. dials, standpipes and glass water gages, trv cocks to operate from floor (all finished parts nickel plated) stop and check valves for feed, blow-off valves, cleaning hose connections with stop valve, all connected up and in place. Each boiler to have a flue damper to operate from the front of boiler. Drum sheets to be of the best open-hearth steel, tensile strength 60,000 lbs. per sq. in. with an elongation of not less than 25% in a parallel test piece of 8 ins. There will also be installed one feed-water heater 4 ft. 6 ins. diameter, 16 ft. high steel shell with 200 3-in. brass seamless tubes 12 ft. long.

FEED PUMPS.—There will be two duplex double-acting pumps, each having steam cylinders 10 ins. in diameter, and water cylinders 6 ins. in diameter having a 10-in. stroke with side valves actuated by simple adjustable lever connections. Each pump must individually furnish sufficient water to serve all boilers. The suction pipe will be 5 ins. and the discharge 4 ins., steam pipe 2 ins. and exhaust 2½ ins. Pumps to be connected with a hot well 4 ft. 6 ins. diameter and 12 ft. deep below floor of boiler room; well to be made of ¼-in. sheet steel well calked and made watertight and set in concrete. All piping to be arranged in duplicate so that either pump can supply any or all boilers. There must also be a gate valve connecting drain water of heater with hot well.

REGULATING SUPPLY OF WATER IN HOT WELL.—All exhaust steam for pumps and engines must pass through heater and a pipe from same must connect with hot well to drain them. Feed pumps connect with boilers passing through heater; steam opening from heater to be piped through roof, and to be finished with back pressure valve and exhaust head. Heater to be fitted with a valve to prevent formation of a vacuum. In addition to the regular gate valve for blowing off, there must be also one ordinary straight cock. Separators and piping to be of wrought iron with cast-iron flange couplings and to be tested to 240 lbs. hydrostatic pressure. Pumps to be connected with cistern in addition to hot well; all steam pipes to be covered with K. & M. magnesia sectional covering, protected with canvas and well painted expansion joints to be where shown on plan and of approved design, and to have at least 8-in. traverse.

ENGINES.—There will be three 24×48-in. horizontal box frame, heavy duty, Corliss engines, to run at 70 revolutions per minute and develop 345 HP. at 1-5 cut-off at 100 lbs. steam pressure. Each engine will be connected to pump with a special laid endless rope 1¼ ins. in diameter. Flywheels shall be made in sections, carefully designed throughout, to give greatest factor for safety; their weight shall not be less than 25,000 lbs. They shall be scored for 11 1¼-in. ropes, and the grooves are to be turned smoothly. They shall also be turned on the sides of the rim, and guaranteed to run true. Rim shall have internal flanges, and shall be carefully fitted with bolts of ample size.

PUMPS.—The main pumps, three in number, will be centrifugal double-suction, each having a 38-in. discharge and 26-in. suction pipes. The runners are to be 60 ins. closed, and of three vane type, operating at a speed of 200 revolutions a minute. Each pump must have a capacity of 37,000 gallons per minute while pumping against a head varying from 0 to 30 ft. The sole or base plates of these pumps will be of close-grained iron of the box girder type, 12 ins. deep, and the main ribs and shell to be at least ¾-in. thick, reinforced at all bolted connections. All joints between base plate case and pedestal stands to be faced, and the same to be located with proper sized dowels. Each sole plate to have 8 holes for 1⅛-in. anchor bolts, and to be reinforced with bosses of proper size for bearing of nut. The casing to be a true volute, of requisite thickness, parted longitudinally as shown on plan, the parting to be faced to a uniform joint, and to be bolted together so as to be perfectly tight while in operation. The water passages from suction pipes through runner casing to discharge pipe are to be made free and uniform with long, easy curves. The elbows are to have approved composition stuffing boxes where shaft passes through the same, so as to be properly packed against leakage. The vanes of runner to be of suitable number, properly curved backwards between the sides of same, and each vane must part and extend towards each suction pipe and be attached to central core which is securely keyed to shaft. Superimposed external vanes are to be cast on the casing of enclosed vanes, to extend from the edge of the suction pipe opening to the periphery of runner; they will be faced off to clear pump casing and exactly parallel with it. Shafts to be of the best refined iron, 6 ins. in diameter, enlarged at hub so as to be full-sized, independent of keyways, and to have thrust rings in bearings. The stand for bearings to be 4 ft. high above base plate, and securely fastened to same; boxes for shaft to be formed in these stands to be self-lubricating, and to be babbitted in position with genuine babbitt. Driving sheaves to be 6 ft. 4 ins. in diameter, of approved design and weight, turned on face and side, and to have turned scores for 15 1¼-in. ropes. Tightener pulleys to be of the size shown on plan, scored for 1¼-in. rope, with proper carriage and guides, supported on I-beams in the manner shown, and fastened to frame work of roof of engine house, having the requisite counterweight (adjustable) to take up slack in the transmission rope. Discharge pipes to be mainly of sheet steel 5-16-in. in thickness; seams to be properly riveted and calked, and the same to be thoroughly dipped in hot asphaltum upon completion. They shall have cast-steel flanges at all connections and where bedded in brick work. Suction pipes to have cast-iron flanges where they pass through brick work, for relieving strain on pump and to prevent leakage.

DRAINAGE PUMP.—For draining the suction tunnel,

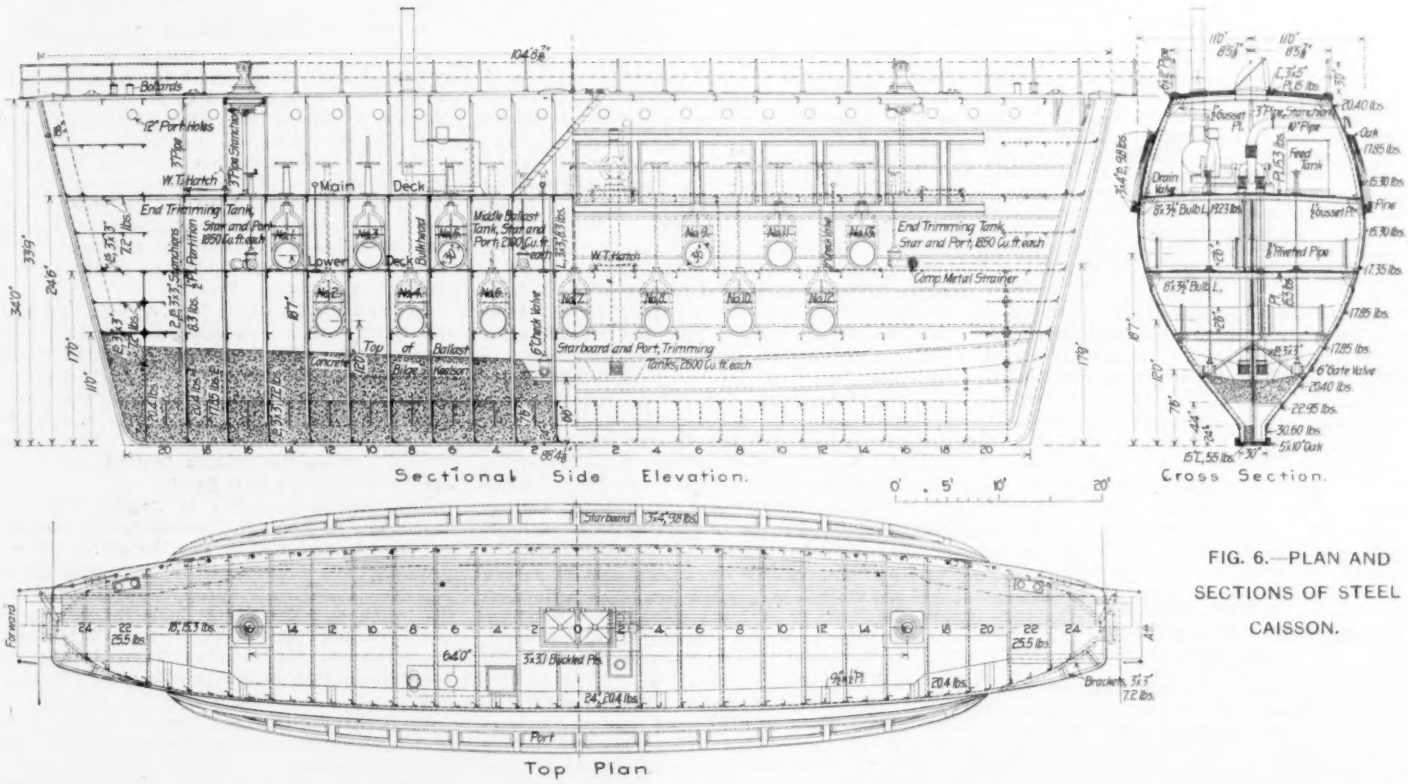

FIG. 6.—PLAN AND SECTIONS OF STEEL CAISSON.

there will be placed in the pump pit, a duplex, double-acting, steam piston pump 12 ins. in diameter, steam cylinders 12 ins. in diameter, water pistons 12-in. stroke, having 2½-in. steam pipe, 3-in. exhaust, 10-in. suction, and 8-in. discharge pipes. This pump will have a capacity of 1,200 gallons per minute under a 40-ft. head. The drainage pump will be properly connected with the 75-HP. water-tube boiler.

PUMP PIT.—The pump pit will be located where shown on plan. It will be 18 ft. wide, 56 ft. long, and 37 ft. deep, all inside measurements. The floor will be supported on an arch of concrete 2 ft. 3 ins. in thickness, and will have in addition twelve 20-in. I-beams, 64 lbs. to the foot, for supporting pumps as shown. The sides of the pit will be of concrete 12 ins. in thickness. The ropeways will be of the dimensions shown, with concrete sides 9 ins. in thickness and bottom of same 6 ins. thick. The sides of pit and ropeways to be plastered with equal parts of sand and cement troweled and floated to a smooth and even surface. The sides of walls to be attached to original rock and all spaces to be filled with concrete. The interior of pump pit and ropeways, when thoroughly and completely dry, to be painted four coats with pure white lead and boiled linseed oil. The gate valves will be placed on each side of the pump pit in the suction tunnel where shown on plan. They will be constructed as shown on detail and must be set so as to be perfectly watertight; they will be worked from floor of engine room by means of the hydraulic cylinders shown, being connected to the water in donkey boiler, and worked with four way cock. Exhaust water must be piped into cistern. There must be by-pass valves in tunnel where shown. They will be 12-in. brass mounted with valve stem stuffing boxes and hand wheel to be worked from pump-room floor. Sump for check valve to be 16 ft. in diameter and 11 ft. deep. Walls to be of brick and bottom to be of concrete not less than 12 ins. in thickness, but the exterior must fit the rock excavation. Pit to be plastered and coated with asphaltum. Covering of well to be of concrete supported on I-beams and expanded metal, as shown with the manhole and cast-iron cover plate. The check valve consists of a cast-iron hinged disk 8 ft. in diameter, properly ribbed for strength, having a cast-iron frame and seat set in brick work of tunnel; it will be raised by a suitable iron wench properly geared for one man power and located on top of well.

For the details and dimensions of the dock which are not given above the reader is referred to the drawings Figs. 1 to 8. As already stated, the dock is to be built by a private concern, the San Francisco Dry Dock Co., of San Francisco, Cal. The officers of this company are: President, Mr. William Babcock; Vice-President, Mr. J. Henry Meyer, and Secretary, Mr. W. F. Russell.

Since the above was written the contract for the construction of this dry-dock has been awarded to the City Street Improvement Co., of San Francisco, Cal., for $404,000. Work will be begun at once, and is to be completed in 18 months.

THE PRESERVATION OF TIES ON THE SOUTHERN PACIFIC RY.

The Southern Pacific Ry. has been using ties treated by the creosoting and burnetizing (zinc) processes since 1887, and we have recently received from Mr. J. T. Mahl, Engineer of Maintenance of Way of the Atlantic System, some particulars as to the preservative treatment and the renewals of treated ties on the Atlantic System of the road. From this material we have prepared the following article:

BURNETIZING.

The Southern Pacific Ry. has been placing burnetized ties in its track since 1887, these being treated at first at the works of the Houston & Texas Central Ry. at Houston, and since March, 1891, at its own plant located on the main line, 2½ miles east of Houston, from which time the plant has been in constant service. This plant consists of two cylinders of boiler plate, 6 ft. diameter and 112 ft. long, each open at both ends, with 26-in. gage tracks running through them; also one cylinder 5 ft. diameter and 109 ft. long, open at both ends, with a 24-in. track. At each end of the cylinders there is an extensive yard, one containing untreated material and the other material which has been treated. Each yard is supplied with steam traveling derricks. In addition there are the engine house with vacuum, oil and water pumps, and a boiler house with boiler and superheater. There are also other structures, such as storage tanks, store house and water tanks. The timber treated is long-leaf and short-leaf yellow pine from eastern Texas and western Louisiana. It is felled at all periods of the year, and no attempt is made to season it either before cutting into ties or after receiving it at the works previous to treatment.

The process used for treating ties is the burnetizing proper; that is to say, the ties are impregnated only with a diluted solution of chloride of zinc. The zinc solution contains 1.6% of zinc chloride, which corresponds to 2.3° on the Beaume hydrometer. The ties are of a "sap" quality, and are 6 × 8 ins., 8 ft. long, containing 32 ft. B. M. each. Each tie receives an average impregnation of 4.5 gallons of the solution. In treating a large number of ties, as the works are called upon to do for this company and its affiliated lines, some timber must be necessarily stored at the works, and this receives natural seasoning to some extent. When ties are treated, some care is therefore taken to charge the cylinders as nearly as possible with ties of the same age, so as to secure uniform treatment, for if green ties and ties which have been seasoned for about 3 to 6 months were subjected to the same treatment, the percentage of absorption by the seasoned ties would be much greater than the absorption by the green ties. The process of treatment is as follows:

First a vacuum of 22 to 24 ins. is created, requiring about 10 minutes. Live steam is next turned in, destroying the vacuum and giving a temperature of about 125° in the cylinder, requiring 15 to 20 minutes. The vacuum pump is again started and a second vacuum created in 15 to 20 minutes. In this way the pores of the wood are well opened and the cylinders uniformly heated. Live steam is then again turned on, and the pressure raised to 15 lbs., giving a temperature of from 240 to 250° F. This requires about 40 minutes. The steam is held at 15 lbs. pressure from 3½ to 6 hours, according to the seasoned condition of timber. Steam is then blown off, taking about 40 minutes. The vacuum pump is again started, and a third vacuum of from 24 to 26 ins. obtained, requiring about 1½ hours. After this, the cylinders are filled with the zinc solution, taking about 25 minutes, and the pressure is then raised to 80 or 100 lbs. and held at this for 1 to 1½ hours, depending entirely upon the kind and condition of the timber. The solution is then run off, taking about 20 minutes. The cylinders are next opened, and the train is pulled up on an elevated platform the height of the floor of a car to facilitate loading upon same, and another charge is placed ready to start again in 40 to 60 minutes from the time of opening the cylinders.

With few exceptions the treated ties have been used exclusively in the main line between Houston and El Paso, a distance of about 836 miles. Cypress ties have been used exclusively between Algiers and Houston, a distance of about 360 miles.

In order that the results obtained during a period covering almost 10 years may be concisely viewed, tables are given showing the total tie renewals in general and treated tie renewals in detail. To make it possible to obtain this information, it has been the practice to stamp the ends of ties immediately after treatment with a brass die, giving the month and year of treatment. Track foremen are required to put the stamped ends of all ties upon the same side of the track, that is to say, on the right hand side going from New Orleans to El Paso. The foremen are provided with a special blank, on which they are required to report at the end of each month the number of treated ties removed by them, and also the causes of removal; whether rotten, shivered or broken, or miscellaneous. These reports are then forwarded to the office of the Engineer of Maintenance of Way, where they are consolidated.

It will be seen from Table No. 3 that nearly all of the 1887 ties have been removed, whilst an unusually large number of 1888 ties have also been taken out. The records for these years show that a large percentage of the removals was due to the ties having been shivered and broken. This cause is also in accordance with observations. The engineer is inclined to attribute this failure to the fact that during the first few years' experience the timber was over-heated during treatment, the temperature in the cylinders at times being as high as 300° F. Again, the strength of the solution first used was 2.5° Beaume, and the process was continued until 0.75% by weight of the pure chloride had been absorbed. The treatment has been varied until at present only 0.50 to 0.55% is absorbed.

The objection to the burnetized ties, as treated on this road, is that moisture will dissolve the chloride around the ends and outer surfaces of the ties, thus leaving an outer shell unpreserved, the timber in the same having resumed its natural condition, which, for the class of tie used, is very poor. The extent of this washing out of the zinc is of course dependent upon the annual rainfall, the quality of the ballast used, and the efficiency with which the embankments and cuts are drained. The effects of moisture on the ties used in the different sections of the country on the Atlantic System were merely conjectural, but in 1896 the engineers commenced the keeping of records in such shape as to be able to study the removal of ties and the causes thereof on each roadmaster's district, which generally average about 150 miles on the main line. It is a little premature to draw any positive or accurate conclusions from the results obtained, but they are given in Table No. III. as having a tendency to show what these might be. Before giving these, a few remarks relative to the physical characteristics of each roadmaster's district might be necessary.

GLIDDEN DISTRICT.—This has a length of main line of 88 miles. It runs through a low, flat, poorly-drained country, with a general rise to the westward of only about 1 ft. per mile. It is laid throughout its entire length with 61½-lb. rails with 4¼ ins. base, and is ballasted with coarse gravel, the ballast section having a depth of 3 ins. in the center of the track over the ties, and gradually sloping in depth from the center so as to leave the ends of the ties free and unimbedded. The thickness of ballast under the ties is 8 ins. The rainfall is heavy, amounting to about 56 ins. during the year.

SAN ANTONIO DISTRICT.—The length of main line is 121 miles. It crosses the drainage of the country; the profile is undulating and the roadbed well drained. Almost the entire length of the line is laid with the 61½-lb. rails. The entire length is ballasted with coarse gravel, with same standard section as on Glidden District. The rainfall is less than on the Glidden District, but no accurate information is at hand.

DEL RIO DISTRICT.—The length of main line is 170 miles; the profile is undulating, the grade at times being equal to 1%; the roadbed is well drained. The entire length of line, with the exception of 8 miles, is laid with 50-lb. rails, with 3⅞ ins. base. The line is ballasted with coarse gravel of standard section. There is little rainfall as compared with the San Antonio District, but no accurate information on this subject is available.

SANDERSON DISTRICT.—The length of main line is 138 miles, and runs through an almost entirely mountainous country, with maximum grades of 1% and maximum curves of 10°. The line is laid about equally with 50-lb. and 60-lb. rails. No ballasting has been done on this district, the ties resting upon the natural bed of soil and rock. The rainfall is very light, being less than that on the Del Rio District lying immediately eastward.

VALENTINE DISTRICT.—The length of main line is 154 miles, and the line runs through a mountainous country with maximum grades of 1% and maximum curves of 10°. It is about equally laid with 75-lb. rail (5 ins. base) and 50-lb. rail, and is ballasted for about 42 miles with fine gravel to the standard cross section. The roadbed is reasonably well drained, but there is very little rainfall.

EL PASO DISTRICT.—The length of main line is 161 miles. It runs through mountainous districts with maximum 1% grades and maximum curves of 10°. The line is laid with about half 61½-lb. and half 50-lb. rails, and for about 55 miles it runs through an arid region. No part of the track has been ballasted and the ties lie on the natural surface of soil and sand. The rainfall is light.

The results of the experience on these districts are shown by years in Table No. II, whilst a recapitulation of results of these years is given in Table III. It must be remembered that the num-

ber of ties shown as having been removed does not represent the total tie removals on these districts, as oak, cypress and redwood ties have been used on them in years past.

It will be observed from the tables that the average life of ties on the Sanderson District has been much lowered, owing to the large percentage of ties removed from accidents and miscellaneous causes. The life of ties on the Valentine and El Paso districts has also been lowered below what was expected owing to the extensive rail renewals

TABLE I.—Tie Renewals on the Southern Pacific Ry. (Atlantic System).

Year.	Miles track, includ. sidings.	No. ties renewed all kinds.	Per cent removed to total in use.	Burnetized Ties.[2] Put in.	Taken out
1887	1,931.56	498,581	9.8	4,144	.....
1888	1,946.	589,969	11.5	118,098	.....
1889	2,018.66	508,150	9.5	196,365	.....
1890	2,025.22	410,153	7.5	212,677	.....
1891	2,049.07	497,617	9.2	180,670	.....
1892	2,063.18	495,287	8.8	247,179	.....
1893	2,085.32	428,053	7.3	179,229	4,268
1894	2,128.65	365,393	6.1	190,769	5,244
1895	2,175.97	430,014	7.0	190,802	16,604
1896	2,192.87	431,628	7.0	165,783	28,961
1897[1]	2,198.28	232,460	3.8	86,737	19,485
1898	2,214.25	394,729	6.4	152,329	53,302
1899	2,274.32	467,776	7.3	207,555	71,489
Total	.....	.....	...	2,132,337	199,353

[1]For 6 months from Jan. 1 to June 30, 1897.
[2]Total removals to June 30, 1899, were 199,353, 9.35% of all burnetized ties put in track to that date.

on those districts. Of a removal of about 108 miles of 75-lb. rail west of Houston during the past three years, about 88 miles have been laid on the two districts in question. In renewing this rail, tie-plates were used on all ties, and in order to insure an even bed or bearing for the plate, such ties as were fit for further use were turned over and the tie-plates applied to the former lower side of the tie. The practice of turning over ties, whilst unquestionably producing the best results in the use of tie-plates, was the cause of a portion of the ties being removed when they would have stood longer service had they not been disturbed. The relative difference in life shown to exist between the Glidden, San Antonio and Del Rio districts may be reasonably taken as representing the relative lives of ties for those districts, although it is thought, and with good reason, that future years will show these lives to be longer.

The track work on these districts during the period in question consisted of ordinary section labor engaged in the repair and maintenance of the roadbed and track. For some years past the repairs of roadbed and track over the entire system have shown a gratifying decrease each year, until for the year ending June 30, 1898, these repairs did not exceed $326 per mile, for that part west of Houston. This is the lowest cost for repairs of roadbed and track that has ever been obtained, and it is in part attributable to the increased percentage of the number of treated ties in the track. There are many other causes which have had their influence in producing this decreased cost of maintenance.

The average cost of treatment per tie of 32 ft. B. M. for the fiscal year ending June 30, 1898, was as follows:

Zinc chloride	2.54 cts.
Fuel	1.04 "
Labor	2.63 "
Maintenance	0.23 "
Total	6.44 cts.

The average absorption of chloride of zinc was 0.55%. The average capacity of the works is 99,000 ties per month when the entire plant is devoted to the treatment of ties.

CREOSOTING.

The method of doing this work at the same plant is as follows: A vacuum of 26 to 24 ins. is created, requiring about 10 minutes. Live steam is then turned in, destroying the vacuum and giving a temperature in the cylinders of about 250°. This requires from 15 to 20 minutes. The vacuum pump is again started and a vacuum is created to open the pores of the wood well and to have the cylinders heated uniformly. Live steam is again turned on and the pressure raised to 15 or 20 lbs., being held at this from 6 to 8 hours, according to the kind and size of timber and the care being taken to prevent the temperature from exceeding 250° F. Steam is then blown off, requiring 40 minutes.

The vacuum pump is again put into operation, and a third vacuum of 24 to 26 ins. is made, requiring about 1½ hours. Whilst blowing off and obtaining this vacuum, and also during its continuance, the superheater is used to maintain a temperature of 225° on the timber. This third vacuum is maintained from 4 to 6 hours, after which the cylinders are filled with creosote oil at a temperature of about 170°. This requires about 35 to 40 minutes. The pumps are then started, and the pressure raised from 80 to 100 lbs. per sq. in., and maintained from one to two hours, according to the kind and size of timber. The cylinders are then opened, after emptying them of the oil, and the train is pulled out and another charge made in 40 to 60 miuutes.

The average capacity of the works is about 1,450,000 ft. B. M. per month, when the entire plant is devoted to the creosoting of timber.

The average time of treatment is from 18 to 20 hours; the average absorption 1¼ gallons per cu. ft. The average absorption is 1.19 gallons per cu. ft. The average cost of the treatment per 1,000 ft. B. M. for the year ending June 30, 1898, was as follows:

Creosote oil	$8.26
Fuel	.59
Labor	1.23
Maintenance	.15
Total	$10.23

It has been found that the woods treated with creosote oil are in no way softened by the process, if they are allowed to stand about six weeks after treatment before being put into service. This conclusion was made by observing that the flange wear on ties before tie-plates were used was not more than on untreated ties, and furthermore, that spikes retained no less degree of hold in creosoted ties than in untreated ones. The experience with creosoted timber on this road extends back to 1886. As to the increased life due to creosoting, it may be noted that the New Orleans and Mobile Division of the Louisville & Nashville R. R. is entirely equippel with creosoted structures. In 1893 they were in a perfect state of preservation after 17 years' service.

The Southern Pacific Ry. specifications for creosote oil are as follows:

The material desired under this specification must be produced in the manufacture of bituminous coal gas, must be completely liquid at 100° F., and must have no deposit take place above 90° F.

In addition to the above, the material must meet the following requirements:

(1.) When distilled at a temperature of 600° F., there must remain not less than 20%, nor more than 35% of undistilled residue.

(2.) It must contain from 7% to 10% of tar acids.

(3.) It must contain from 20% to 30% of napthalene.

TABLE II.—Annual Record of Treated Ties Laid and Renewed, by Years; Southern Pacific Co. (Atlantic System).

	Year treated	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	
No. of treated ties laid same year		4,144	118,098	196,365	212,677	180,670	247,179	179,229	190,769	190,802	165,783	86,737	152,329	207,555	2,132,337
Removed each year	Year Removed														Total Removed
	1893	472	3,199	528	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,268
	1894	1,020	3,602	547	67	8	.....	.....	.....	.....	.....	.....	.....	.....	5,244
	1895	1,156	10,665	3,337	940	185	46	269	6	.....	.....	.....	.....	.....	16,604
	1896	1,401	16,883	5,545	3,536	936	336	177	18	129	.....	.....	.....	.....	28,961
	1897	95	9,419	3,867	4,424	1,035	444	120	79	1	1	.....	.....	.....	19,485
	1898	...	20,638	12,517	9,706	4,293	3,845	1,504	493	110	165	1	30	.....	53,302
	1899	...	29,935	17,487	13,192	5,227	3,790	1,023	448	230	7	46	104	.....	71,489
Total number removed		4,144	94,341	43,828	31,934	11,684	8,461	3,093	1,044	470	173	47	134	.....	199,353
No. of years in track on July 1, 1899		10	11	10	9	8	7	6	.....	.....	.....	.....	.....	.....	.....
Per cent remaining in track July 1, 1899		0	20	78	85	94	97	98	.....	.....	.....	.....	.....	.....	.....

TABLE III.—Burnetized Ties Removed from the Several Roadmasters' Districts During the Years 1894, 1895, 1896, Six Months of 1897 and Fiscal Year 1898 and 1899:

Districts.	No. ties removed.	Cause of removal. Rotten. No.	%	Shivrd-Brkn. No.	%	Accdnts. & Misc. No.	%	Avr'ge life. Yr.	M.
Glidden	10,579	9,798	93	773	7	8	..	6	11
San Antonio	82,855	74,230	90	8,143	10	482	..	8	4
Del Rio	33,374	30,098	90	3,167	10	109	..	9	2
Sanderson	11,807	9,927	84	658	6	1,222	10	8	5
Valentine	25,311	22,079	87	2,473	10	759	3	7	6
El Paso	31,159	24,931	80	4,396	14	1,832	6	7	10
Total	195,085	171,063	88	19,610	10	4,412	2	8	3

THE BRITISH HONDURAS RAILWAY contract which is now open to bidders calls for the formation of a company with a nominal capital of about $6,000,000. In accordance with specifications, the company is to construct and equip a railway, single line, 3 ft. gage, running from Belize through the colony to the western frontier; also a landing pier at Belize, so constructed that the depth of water at the sea end for at least one hundred years, shall never be less than 19 ft. at low water. The Guatemala extension is to be of the same gage. Surveys must be begun within three months from the date of contract. The tolls for conveying pasengers or goods and for the use of the pier are to be subject to the approval of the government. At least one train per day shall be run each way, carrying passengers at an average speed of not less than 12 miles per hour, on all parts that are open for traffic. The government will not grant concessions for railways in the colony without first offering the same to the company, and will grant the company running powers over any other railways constructed. The company may, after the works are completed, issue debenture capital. After the works have been opened 25 years the government may, on twelve months' notice, purchase the railway and pier. The government shall pay a subsidy of $364,989 in gold in five installments of $72,997, one for each of the sections of the railway as finished; also a subsidy of 200,000 acres of Crown lands, to be allotted in a manner provided—40,000 acres for each section, half to be granted on completion of the section and the remainder on the completion of the entire works. The latter lands are to be forfeited if the railway and pier and the Guatemala extension are not opened within the time agreed upon. Minerals found are the property of the government. If the company fails to comply with the contract, the government may terminate it and proceed itself with the works, the company repaying all moneys received in respect of the cash subsidy. All the works are to be of substantial character. The steepest gradient permitted shall be 1 in 35 on straight tangents, and the smallest radius of curvature permitted 262 ft. The rails shall be of flanged steel, weighing not less than 40 lbs. per yard. Sleepers are to be of colonial wood, 6 ft. long and 4½ ins. deep and not less than 7 ins. wide, and laid on an average 2 ft. 5 ins. apart.

SOUTH AFRICAN RAILWAY CONTRACTS are interesting American manufacturers, and incidentally giving trouble to the British War Office, which denies making awards to America. It is admitted by that office, however, that the Colonial Office and the South African Colonial government may be responsible for such contracts. On the other hand, Joseph Westwood & Co., of England, writes to the London "Daily Express" and complains that since Oct. 1 steel viaduct structural work, worth $500,000, has been placed in the United States by the government of the Uganda District. The work to be done in South Africa is valued at $7,500,000, and includes the purchase of new rolling stock, locomotives, bridges, machine shops and the reconstruction of railway lines. As showing that Americans are after their work, we have the warning of Sir Walter Peace, the Natal Agent-General, that to compete successfully against Americans the British firms will have to realize more fully that time is the essence of contracts and that they must lower their prices.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Entered at the New York Post-Office as Second-Class Matter.
Published every Thursday
at St. Paul Building, 220 Broadway, New York, by
THE ENGINEERING NEWS PUBLISHING COMPANY

GEO. H. FROST, ... PRESIDENT.
D. McN. STAUFFER, ... VICE-PRESIDENT.
CHARLES WHITING BAKER, SECRETARY AND MANAGING EDITOR.
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ALFRED E. KORNFELD, New York,
M. C. ROBBINS, Chicago,
S. B. READ, Boston,
C. F. WALKER, Cleveland,
} ADVERTISING REPRESENTATIVES.

PUBLICATION OFFICE, 220 BROADWAY, NEW YORK.
CHICAGO OFFICE, 1636 MONADNOCK BLOCK.
BOSTON OFFICE, 170 SUMMER ST.
CLEVELAND OFFICE, OSBORN BUILDING.
LONDON OFFICE, EFFINGHAM HOUSE, 1 ARUNDEL ST., STRAND.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; *6 months,* $2.50; *2 months,* $1.00. *To all other countries in the Postal Union: Regular Edition, One Year,* $7.60 (31 *shillings*); *Thin Paper Edition, One Year,* $6.31 (26 *shillings*). *SINGLE COPIES of any number in current year,* 15 *cents.*

In requesting change of mailing address, state BOTH old and new address; notice of change should reach us by Tuesday to be effective for the issue of the current week. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 320 *means that subscription is paid to the* 32*d week (that is the issue of Aug.* 9) *of the year* 1900; *the change of these figures is the only receipt, unless one is sent by special request.*

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The cause of flat spots on locomotive driving wheels was pretty thoroughly investigated by members of the Western Railway Club a half-dozen years ago, and the conclusion was reached that they were due to the counterbalance weights. At high speeds that portion of the counterbalance which is applied to partially balance the reciprocating parts of the engine exerts a considerable force, tending to lift the wheel off the rail. Against this force is to be put, of course, the weight of the wheel and its load; but the net pressure on the rail at high speeds may become small enough for the steam pressure to slip the wheel a very short distance when the counterbalance is up.

Now, however, an Englishman brings forward a new theory as to the cause of flat spots on driving wheel tires, and it is elucidated in "The Engineer" of Sept. 21 as follows:

> The flattening is due to slight slip, which goes on continuously, and which is brought about by the variations in the crank effort, and the unavoidable slackness of the side rods and axle-boxes. As we have often explained, a locomotive is propelled alternately by the pressure of the steam on the leading cylinder cover and that of the crank axle on the leading-hornplate. The axle-box can play a little backwards and forwards. The result of all this is that the leading driving wheel slips a little at each revolution until the side rod stops it. This little "kick" takes place always when the crank is up, for obvious reasons; but that is the time when the balance weight is down near the rail, and so the flattening has been attributed to the weight. No one says, be it observed, that hammer-blow action is innocuous; but only that the varying movements of the crank effort contribute powerfully to the same end.

It is undeniably true that the parallel rods on a locomotive transmit tension and compression alternately, but the change from tension to compression is made at the end of the stroke, when the cranks to which the rods are attached are exactly on the dead center. Even if we suppose a perfectly-fitted main rod and a loosely-fitted parallel rod, therefore, it is not easy to see how the main rod can slip the main driver when in this position, no matter what the slack in the parallel rod connections.

This is our first difficulty with the new theory. We find a second when we are assured that "this little 'kick' takes place always when the crank is up for obvious reasons;" but the reasons are far from being obvious, as least to us.

It may be remarked that this theory is put forward to justify the perpetration of a three-cylinder compound with three cranks on one axle set at angles of 120°, by which it is said, the inventor "has almost entirely got rid of flattening and greatly promoted the durability of his tires." We may note in this connection that some American locomotive designers have reached the same happy result by an intelligent revision of the counterbalance weights.

Some other information which should prove highly interesting, or at least entertaining, to American designers of compound locomotives, is given as follows:

> In the Riekie engine (the three-cylinder compound above referred to) the high-pressure cylinders are the full size that a simple engine ought to have, and all three cylinders drive on to one crank shaft. To all intents and purposes the two high-pressure cylinders act as if the low-pressure cylinder was not there; but instead of exhausting into the air up the chimney they exhaust into an intermedite receiver. In order that their actual power and turning moment may not be reduced because of the augmented back pressure, the boiler pressure is raised. The low-pressure cylinder develops about as much power, let us say, as either of the other two. As about the same weight of steam will suffice, this effects an economy of, say, in round numbers, 33%. Deductions have to be made; but, on the other hand, because of the augmented economy and the increased power, Mr. Riekie can cut off at about 25% of the stroke in the small cylinder. This would be impossible with the simple engine, and represents a considerable saving in fuel. Summed up shortly, Mr. Riekie, by increasing his boiler pressure, can apparently get about one-third more power for the same coal consumption.

This is lovely. We have never run across a simpler explanation of the economy effected by compounding anywhere. "The two high-pressure cylinders act as if the low-pressure cylinder was not there." Of course the back pressure is forty or fifty pounds higher; but you raise your boiler pressure forty or fifty pounds and just offset this!

Further on we are told that this engine "can cut off at about 25% of the stroke in the small cylinder, which would be impossible with the simple engine." Our curiosity is again aroused. From what complaint do English simple locomotives suffer that prevents their cutting off at 25%? American locomotive designers have labored under the impression that a longer cut off was necessary in a compound locomotive than in a simple engine, to produce the best results. In this engine, however, to quote again from our contemporary, "the action of the steam in the low-pressure cylinder goes far to compensate for the loss of useful effect produced by an early cut off with the link in the high-pressure engine."

Certainly a machine which can be made to perform such acrobatic feats of thermodynamics as those above described deserves a wide measure of notoriety.

In his lately-issued annual report, Rear Admiral George W. Melville, Chief of the Bureau of Steam Engineering in the U. S. Navy Department, says that the Naval Personnel Bill—passed after so much discussion and effort—is very unsatisfactory in its working. Under the provisions of this bill every line officer of the Navy is to be in time an engineer officer, and the old separate staff of steam engineers was abolished. Admiral Melville now says that the scheme was either a mistake and impracticable, or the proper course has not been taken to carry out its intent. He inclines to the latter opinion, and charges results to a lack of full appreciation, on the part of the Navy Department, of the urgent need of haste in providing the requisite trained engineers, and in affording the fullest opportunity for the acquirement of practical engineering knowledge on the part of the younger officers of the line. The demand for expert engineering officers is immediate and constantly increasing, and he says that this demand can only be met by at once assigning the younger officers as assistants and understudies to the experienced engineers now in charge of engines afloat and ashore. The Department, it seems, has adopted the opposite policy of assigning former engineers to line duty; and so many have been thus transferred that those performing purely engineering duties are much overworked. In fact, on some of the smaller vessels there are no expert engineers at all, and the line officers in nominal charge of the engines must depend entirely upon the warrant mechanics for the care of the machinery. Admiral Melville warns the Department that possible disaster lies in this insufficiency of the engineering force, and that this force is kept at its point of elastic limit even in time of peace. A war would develop a large list of physical incapables in the engineering branch of the service. As it is, he believes that good fortune alone has postponed casualty.

This expert opinion, coming as it does from one in the best position to know of what he speaks, should carry weight with the Department. As all now know, the Personnel Bill was a compromise, and was only passed in its present form after a long and bitter controversy. The old line officer was not willing to admit that the duties and responsibilities of the engineer now equalled, if they did not surpass, his own; and he finally proposed to get out of the difficulty by abolishing the engineering staff as a distinct branch of the service and grafting its duties onto those of the line. In this form the bill passed.

The report of Admiral Melville, however, shows that the old leaven is still working, and working towards possible disaster in our Navy. Those in charge of the conduct of the Navy Department are line officers, and they are still so imbued with the traditions of the line that they evidently deem it of more importance to galvanize former engineer officers into line officers than to train the young line officers in the vital knowledge of the proper maintenance and management of the machinery that now crowds our warships. The line officer still believes that the care of this machinery is a mechanic's work, and that the warrant machinists can do all that is necessary and leave the commissioned officer nominally in charge to wear clean clothes and perform the more ornamental duties of his position. As Admiral Melville truly says, they utterly fail to appreciate the real demand for trained commissioned officers who are competent to command by reason of thorough expert knowledge, and have the authority necessary to enforce their commands. Our Navy is growing rapidly, and each new ship increases the demand for trained engineers; and, while the warrant machinist fills his place and fills it well, the prevailing conditions do not make commissioned officers of them, and never will. To avert disaster and to make our Navy really efficient in all its branches, we must have less red tape and tradition, and more common sense in the conduct of what is now undoubtedly the most vital branch of the naval service in peace or in war—the soundness and proper handling of its machinery.

If anything were needed to justify the remarks here made as to the position taken by the line officers who manage naval affairs, we have it in the comments of Admiral Melville, on the proposed consolidation of several of the bureaus of the Navy Department into a Bureau of Ships, under one head. This law would abolish the separate bureaus of Construction, Steam Engineering and Equipment. Admiral Melville wisely says that there is now in existence a Bureau of Ships, called the Navy Department, and the Secretary of the Navy is the head of that bureau. The only evident purpose in the proposed consolidation is again to put a line officer over the steam and civil engineers, and to thus further advance the old claim of superiority. To do so would be to remove the only existing barrier against hasty and ill-considered action in the design and construction of our warships, and such action would place the supreme command in hands not fitted by previous training or expert knowledge to act for the good of the service. Such a step would be a step backward with a vengeance; and while Secretary Long seems to approve it on the ground that it would avoid the differences of opinion that now sometimes prevail, differences of opinion between the expert and non-expert are very natural, and are a healthful symptom, so far as the efficiency of the service is concerned.

THE DUAL WATER SUPPLY OF PARIS AND THE COMPARATIVE MERITS OF SPRING WATER AND FILTERED WATER.

The dual water supply of Paris has been subjected to a severe test for the past few years, which culminated in something quite like a breakdown during the past summer. Whether the latter was due to causes of long standing, to temporary climatic conditions, or to the increased population incident to the great Exposition, we cannot say, but it appears from an interesting article in the "Technologie Sanitaire," abstracted elsewhere in this issue, that the daily suspension of the water service of Paris for seven hours of the night, begun on July 21, was made necessary by a combination of these causes. This experience in the French capital is particularly interesting because the potable water is brought from distant springs, and is all metered. While the water-works are owned by the city, the water is distributed and the water rates are collected by a private company. The detailed figures for consumption during the quarter covering the period of restricted service are not available, but from the department reports for 1897 some very instructive figures have been drawn by the author of the article in question. These we will not repeat here, further than to note the following facts: During 1897, Paris used 57 gallons of water per capita per day, of which 32 gallons was for the private service and 25 gallons, or nearly half, for the public service, the total population being taken as 2,550,000. Notwithstanding the existence of a secondary supply for public and industrial purposes, and the repeated deficiencies in the spring water supply for years past, 20% of all the spring water brought into the city in 1897 was used in the public service; and, it so happened, that an equal percentage of the total public service was supplied with spring water. Mr. Kemna draws two lessons from the experience of Paris: (1) The general impracticability of a dual supply; and (2) the great reduction in cost and the lessened danger to health that might be effected by the application of sand filtration to the water of the Seine. Again and again, those in charge of the water supply of Paris have been compelled to turn river water into the spring water mains; in which case householders are notified in advance. To avoid contaminating the whole system of mains, the river water has been restricted to one quarter of the city, and, in addition to the notification named, public fountains, from which drinking water could be carried, have been supplied with spring water. In 1899, there were 4,300 deaths from typhoid fever in Paris, or 161.8 per 100,000, a higher figure than had been reached since 1892. Perhaps this warning, coupled with some consideration for the thousands of extra visitors in Paris this year (and not an unusual deficit in the supply), led the authorities to discontinue the water service from 11 p. m. to 6 a. m. this summer, instead of turning polluted water into the domestic mains.

Another fact worth noting is that, if Mr. Kemna's calculations are correct, the meters in Paris fail to record 35% of the spring water supply. The authorities assert that the street mains are perfectly tight, which seems to leave under-registration of the meters as the only, or at least the chief, means of accounting for over one-third of the spring water. It was found, in 1897, that of 18,049 domestic meters examined, one-third were defective, or one-twelfth of all the meters in use. We commend these statements as to the failures of French water meters to the American manufacturers of that line of water-works supplies.

The experience of Paris furnishes food for reflection to the comparatively few who have advocated dual water supplies in this country, and who favor the securing of naturally pure water from distant sources rather than filtered water nearer at hand. Dual supplies, we hasten to say, are quite different from supplementary supplies of unpotable water for limited industrial sections, or for fire protection in special districts, or even for street sprinkling and sewer flushing. The full conception of a dual supply includes two sets of pipes for each street, and in each building, one conveying a high grade of potable water, relatively small in quantity, and the other carrying water for all other needs.

This plan, while often reducing the cost of developing a water supply, would always greatly increase the expense of distributing it, since the abstraction of the small quantity of potable water required only slightly reduces the capacity and cost of the main distributing system over that employed for the combined service, and requires a large total outlay for the duplicate street mains, house connections and plumbing. There might be a marked saving in the cost of storage reservoirs, with the dual system, as described below in discussing the advantages of filtering nearby sources, under the present combined system. One possible advantage in distribution systems, under the dual plan, would be the use of cheaper service pipes for the general supply, and a higher grade of pipes for the potable water, but this would rarely apply, except where there is danger of lead poisoning, or some like trouble.

Besides the increased cost of dual distributing systems, there must be considered the constant menace to health and life due to the carelessness of large portions of the population, who would drink the water which was handiest or the most to their fancy, even if it were known to be polluted and dangerous. This may seem to be a severe reflection on the intelligence and prudence of large numbers of city and town dwellers, but it is a well-known fact which cannot be disregarded. It is not enough to say that pure water having been provided, municipal responsibility ceases and individual responsibility begins. On that basis, a large part of present-day municipal work in both the health department and the police department (and the two are more closely related than is generally appreciated) would remain undone. Besides protecting those who will not look out for themselves, the balance of the inhabitants would be endangered by the careless use of impure water, both through those engaged in domestic service and through secondary infection from those suffering from typhoid fever, through their own heedlessness or ignorance.

As to filtering water from nearby sources, rather than going far afield, it is becoming more and more evident that the search for anything like a permanently safe natural surface water is growing more hopeless, and its development and conservation more costly as population increases, while at the same time the rapid advances in water purification are putting that art on a more scientific and economical basis, with each succeeding year. Moreover, stream pollution does not have so dark an aspect as formerly, thanks to the progress of sewage purification and the increasing intelligence of legislators, courts, city officials and the general public; so that while we cannot expect to keep all sewage pollution away from water intakes located on streams flowing through populous districts, we may hope to see the evil kept well within the possibilities of rectification by means of properly designed and operated water purification works.

Go as far into the sparsely settled highlands as a city may, few if any large communities can long safely use unpurified surface water supplies. Besides this, the tastes and odors which often are present in water taken from huge artificial storage reservoirs will be added arguments for water purification as time goes on and the essential qualities of a thoroughly satisfactory water supply become more generally understood. Purification makes possible the utilization of streams lower down in their courses, where the minimum flow is sufficient to render large storage capacity unnecessary. It may also diminish the expense of such storage as is provided by lessening the amount of excavation, or of sand covering, required to render innocuous deposits of muck or other organic matter.

In conclusion, we desire to call particular attention to the remarks on the tendency of engineers and municipal officials to urge and carry out the development of costly supplies from distant sources rather than the curtailment of waste. These remarks were quoted by Mr. Kemna from an article in the "Revue Industrielle." They apply to other public works than water supplies, and to American cities with even more force than to foreign cities. They deserve to be brought to the attention of all municipal officers and taxpayers in this country, beginning with New York city. They are particularly applicable to Greater New York, during its present agitation over water supply and water waste.

LETTERS TO THE EDITOR.

The Advantages of Arched Masonry Dams Over Straight Dams.

Sir: In reading the account of the failure of the Austin dam, and also the Minneapolis dam, I cannot help thinking that both structures might still be intact if they had been arched. The masonry appears to have been of excellent quality, and the experience gained in the Bear Valley dam in California shows the enormous increase in strength gained by curving a dam. The calculations made by Mr. Vischer and myself (see paper on "The Strains in Curved Masonry Dams," Proceedings of the Technical Society of the Pacific Coast for December, 1889) show the enormous resistance gained by curvature. This dam is of startlingly slender dimensions; to wit: 43 ft. high, 8½ ft. thick at the base, and 3¾ ft. at the top. When the reservoir is nearly full the dam has also been subjected to the thrust of more than 2 ft. of ice. The paper referred to shows that but slight increase in the quantity of masonry is required to gain this reserve strength, and it is the writer's opinion that if curvature is properly used, the amount of masonry need not be increased to give a dam at least double the stability of a straight dam.

Very respectfully,
Luther Wagoner, C. E.

849 Chestnut St., San Francisco, Cal., Sept. 29, 1900.

Setting Slope-Stakes.

Sir: While you were on the subject of slope stakes, it seems that your remarks would have been complete had you quoted from Shunk's Field Engineer, page 30:

Setting Slope-Stakes.

Like swallowing, this is more easily done than described. To no detail of field service does the proverb more fitly apply, that "work makes the workman."

Yours truly, J. G. Walker.

Nashville, Tenn., Oct. 19, 1900.

Sir: The special tape for setting slope-stakes has been on the market as "Ward's Patent" for some 20 years, as may be readily seen by any one referring to Keuffel & Esser's lists. My first knowledge of the device was in the fall of 1881, when I was told of it by Frederic Danforth, C. E., now engineer member of the Maine Railroad Commission. I first used the tape on the B. & P. R. R. (now a part of the Bangor & Aroostock system) in 1883.

Yours truly, O. H. Tripp.

Rockland, Me., Oct. 20, 1900.

Sir: Regarding the use of the slope tape and rod described by me in your issue of Sept. 13, I must admit that it was but a re-invention, if, as Mr. La Rue states, a similar device was used in 1881. Mr. Wrentmore (Eng. News, Sept. 20), from information given in a personal letter, appears to have used a rod similar to mine, excepting that rollers were provided at the ends, but as I first used my rod about 8½ years ago, I had some doubts as to his priority of use until I saw Mr. La Rue's contribution. Your editorial criticism of our technical schools is right to the point and I trust will lead to improvements in methods of instruction and a selection of instructors who have themselves served an "apprenticeship" after graduation.

Yours very truly, H. P. Gillette.

Rochester, N. Y., Oct. 19, 1900.

Sir: It surely is a pity that many excellent devices, like the slope tape and the rod with changeable figures, make such very slow progress. No formulas or figures or mental calculations of any kind are needed in finding the places on the ground for slope stakes, in either cut or fill, or cut and fill, or the grade points on a section part cut and part fill, no matter how many times the level has to be set up between the center and side stakes. It requires a few simple figures to prove the places to be right before entering the record in the notebook; but nothing of the kind is required to find the right places on the ground, and were one content to go on without checks, nothing at all of the nature of a calculation would be needed. The level may be set up so many times for half a cross-section that a temporary record may be necessary to keep track of the data; but no "figuring" is required.

Very respectfully, J. B. Davis.

Ann Arbor, Mich., Oct. 22, 1900.

Sir: Your series of letters on the subject of setting slope-stakes has been very interesting, and the conclusions drawn from the discussion in your editorial of Oct. 18th are most sensible and timely. Let me quote a suggestion from a practical man which seems to embody your conclusions in a formula easily remembered. The writer, after a year's experience in running a transit on railroad preliminary and location in the Northwest, and holding a tape for a few days on cross-sectioning, was directed by

the chief of the party to go out and cross-section a part of the line. On being told by the young man that he did not know how to do it, the chief said, "You never will know how if you don't begin—go out and make a stagger at it." On the way out to work, one of the axemen, a veteran who knew a railroad when he saw one, having braked freight trains or stolen rides on brake beams all over the West, assured the young man of his sympathy by remarking, "Now don't make no false motions. You want to make a record at this." The writer has cross-sectioned many miles of railroad since then, and has seen no reason to substantially change the methods learned in those few anxious days. Perhaps Jack Conly's formula is as good as any, "Don't make no false motions." T. S. Burr.

53 State St., Boston, Mass., Oct. 20, 1900.

Sir: Your continued editorial extending to nearly two columns in your issue of October 18 is provocative of a rather sharp reply. As past-Secretary and past-President of the Society for the Promotion of Engineering Education, which includes in its membership over 250 of the teachers of engineering in this country, I think I have some right to speak for the engineering professors. Furthermore, the original communication to your valuable journal in the issue of July 19 last, made two critical references to my work on "Surveying." I noted this at the time, but considered it of no material consequence and so ignored the criticism. If you will allow me to make a suggestion in the line of the duties of an editor to his readers, I would say that this original communication in the issue of July 19 never should have been published. It came from a man who, I believe, is wholly unknown amongst the teachers of engineering in this country, and furthermore, from a man who is engaged, not in teaching in any regular school, but in a correspondence school, which is not recognized either inside or outside of the profession as a school of engineering, properly so called. Furthermore, his name would indicate that he is a foreigner, and if so probably not competent to speak for Americans and their methods of instruction even though he had been engaged in teaching in a regular school of engineering. This original communication also bore upon its face evidences of incompetency, inasmuch as the methods the writer proposed were such as no American engineer in actual practice would for a moment think of employing. Why it should have been published, therfore, I cannot understand unless it was to insert something which would cause a series of counter letters of protest. If this were the purpose of its publication the object has been accomplished. I have noted the correspondence on this subject, and have been surprised that the original communication should have attracted so much attention, in view of its patent impracticability. Imagine, however, my very great surprise on receiving a copy of the current issue, October 18, to find that the editor of the journal had taken this original communication as a text from which he might preach a sermon to the entire body of engineering professors in America! The whole subject of setting slope-stakes is one of such simple practicality, and is, I believe, always properly taught in its simplest and most practical forms in all the schools of engineering in this country as well as in the standard text books, that it would seem to be the last subject in the world on which to base an argument for reform in the methods of imparting instruction in our schools of engineering. I am also surprised that the editor of the leading engineering journal in this country, which journal has maintained such intimate relations with the engineering schools, should be so ignorant of the kind of instruction which is given in these schools as to feel warranted in casting the severe reflections upon these methods which are contained in the editorials in question. It is because this journal stands so high in the profession and is supposed to represent both engineering education as well as engineering practice in this country, that this editorial appears to be both unjust and injurious to the cause of technical education. If the original communication were from a professor in one of our leading schools of engineering, and if the correspondence had shown that such highly theoretical and impractical methods of instruction were being pursued in our schools, I think your editorial would have been fully justified. As it stands, however, I feel that it has no application to our schools of engineering, the instruction in which is annually becoming more and more practical and efficient, and nearly all of which is now imparted by men who have had a very considerable experience in actual practice. I trust, therefore, you will give this protest the same publicity which your editorial has received.

Very truly yours, J. B. Johnson,
Dean, College of Mechanics and Engineering, University of Wisconsin.

Madison, Wis., Oct. 20, 1900.

(It appears to us that the dozen letters which have been drawn out by the communication printed in our issue of July 19 (among which the last one printed above is certainly by no means the least valuable and interesting) are full justification for the admission of that first letter to our columns. As most of our readers are aware, it has long been our practice to hold a rather loose rein over the contributors to our department of Letters to the Editor, and the interest which our readers show in the discussions there carried on seems to us to fully justify this policy.

As for our remarks concerning methods of instruction in American engineering schools, to which Prof. Johnson takes exception, we shall freely admit at the outset that like other preachers in other pulpits, our sermon far outgrew its original text. Nevertheless, and also like some other preachers, we are not ready to consent that a flaw in the text shall cast the whole sermon away. Even Prof. Johnson, we are sure, will not claim that American engineering schools are all and severally beyond criticism. In fact, we seem to recollect some peculiarly pointed and useful criticisms in this field which have emanated from his own acute pen.

The question narrows down, then, to the simple one of whether the particular criticisms which we made were on the whole justified. Our criticisms were two. First, that the change from the apprenticeship method to the engineering school method of training engineers had brought some loss, together with great gain. Perhaps we have given too much credit here to the old-time plan of training engineers. It makes little difference, for it has gone, never to return. The practical point is whether the instructors in engineering schools to-day, when they attempt to teach engineering practice, are really able to present up-to-date methods to their students. That some of them can and do, we know; and we are also strongly of the belief that a large proportion of engineering instructors are endeavoring, so far as their circumstances will admit, by study of technical journals, by contact with men in active life, and by actual conduct of work in some cases, to keep themselves in touch with the latest practice in their specialty. Some of these are succeeding to a gratifying extent; but is this true of all? and are there not some who find the task too difficult a one, and others who are content to merely follow old-time precedents in the old-time way?

As for our final criticism—that there is still too large a proportion of the students' effort devoted to mathematical gymnastics in our engineering schools, in comparison with the time given to other departments of study—we find no specific contradiction of this in Prof. Johnson's letter.

We trust on mature reflection he will revise his opinion that our modest "preachment" will "prove injurious to the cause of technical education." Other sermons are preached to other congregations and those of conscious virtue sit with equanimity while their sinning brethren are told of the error of their ways. If our sermon has no application to those at whom it was directed, then so much the worse for the preacher's reputation! We must still believe, however, that with all the progress American engineering schools have made, there are still some few which can take our discourse to heart, with profit to themselves and those whom they teach.—Ed.)

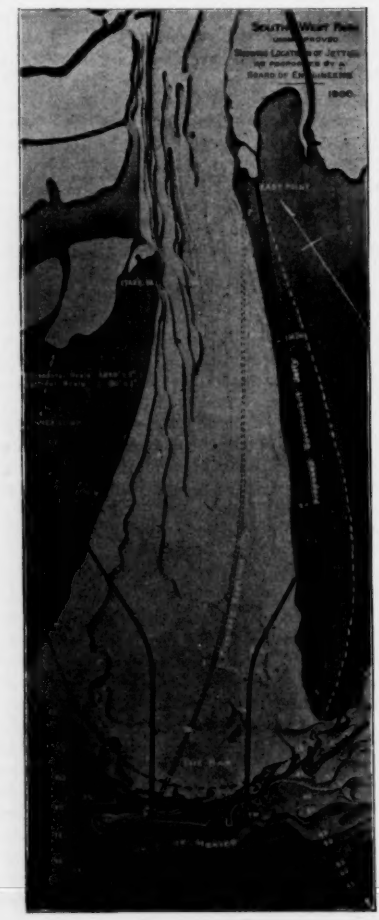


Fig. 1.—Plan Proposed by Board of Engineers of 1899.

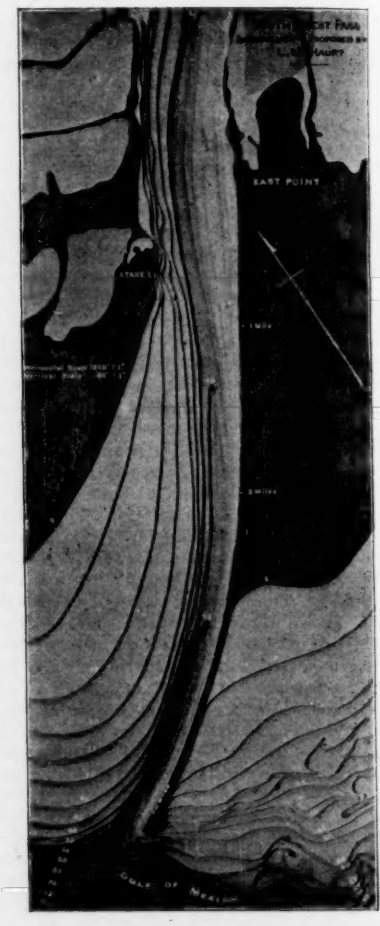


Fig. 2.—Plan Proposed by Prof. L. M. Haupt.

RELIEF MODELS OF SOUTHWEST PASS AND ALTERNATIVE PLANS FOR ITS IMPROVEMENT.

The Erosion of River Bends.

Sir: In the issue of Engineering News of Oct. 11, 1900, Prof. Lewis M. Haupt outlines his plan for the improvement of the Southwest Pass of the Mississippi. The theory upon which he bases his design is given in the July number of the "Franklin Institute Journal." The theory as there stated is so erroneous as to merit more than a mere denial of its truth. We shall first give in Prof. Haupt's own words his theory of the scouring action of water at bends in a stream.

If, therefore, this percentage (66%) of the discharge be deflected from its natural egress and be confined to the immediate vicinity of the guiding jetty (Fig. 2) it would represent 133,000 cu. ft. of water, weighing 3,700 gross tons, sweeping along the face of the work at the rate of 1 ft. every second, in addition to the 66,000 (the other 34%) cu. ft. or 1,850 tons already traversing the same area.

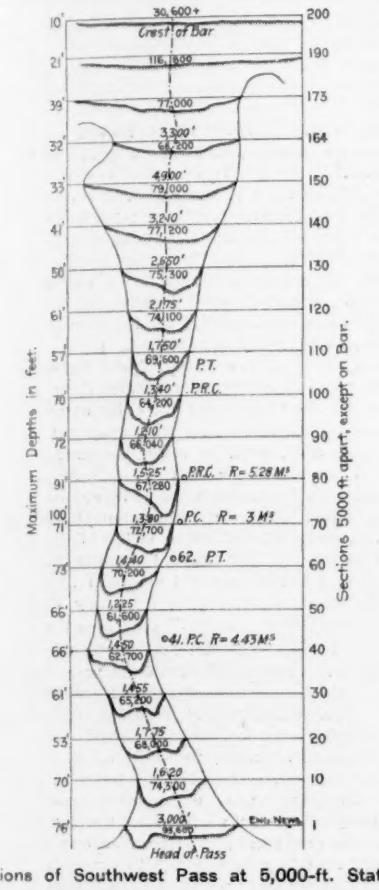
Coming from an engineer of Prof. Haupt's standing, this is the most remarkable statement that it has ever been our fortune to see in print. Continuing, he says:

This is approximately correct, and serves to illustrate the great increment in concentration and discharge over a limited path, which must result from this form of construction. In other words, if instead of only one-third, the entire discharge be voided over a limited sector of the bar there must result a threefold increase in velocity or a triple increase in the water section across that region of the bar.

Concentration of energy is caused by compression of currents; dissipation, by expansion.

A single concave jetty so placed as to encroach gradually upon the path of a stream does produce a compression, causing reaction, deflection and deep erosion.

For a confusion of words and mechanical theories it will be hard to equal the above. What does Prof. Haupt mean



Sections of Southwest Pass at 5,000-ft. Stations.

by "compression of currents?" How can currents of water be compressed?

How can the 133,000 cu. ft. of water be "confined to the immediate vicinity of the guiding jetty" in addition to 66,000 ft. already there? If Prof. Haupt does not mean what his words clearly say, what does he mean? If he means that his curved jetty, indicated by the dotted lines in Fig. 1, contracts the open channel to one-third its original area, he has not shown that to be the case and cannot.

We believe that in an endeavor to account for the erosion of the concave bank of a stream, Prof. Haupt has fallen into the common error of supposing that the water following the concave side does, in virtue of centrifugal force, attain a greater tangential velocity. If Prof. Haupt does not mean this, his words mean nothing; for a "compression of currents" is an expression incapable of explanation or illustration.

Prof. James Thomson was, we believe, the first to overthrow the theory of increased tangential velocity along the concave face of a bend. Under "Hydromechanics," in the Encyclopedia Brittanica, Prof. Thomson's theory is given, together with a statement of his experiments. By means of analine and seeds floating in a current of water he proved conclusively that the tangential velocity at the concave face of a current of rectangular cross-section is actually less than it is at the convex face of the curve, which is exactly contrary to the common hypothesis. Prof. Thomson further showed that there are transverse currents generated, as he believed, by the head due to the inclined surface assumed by water under the action of centrifugal force, as illustrated in Fig. 3, and that it is these transverse currents that scour the concave side and bottom, depositing the scoured material on the convex side of the stream.

While the writer cannot accept this theory in its entirety, still the results of Prof. Thomson's experiments utterly discredit Prof. Haupt's confused explanation of erosion at river bends. If Prof. Thomson's theory offered a full explanation of the phenomenon, we ought to find a uniform depth of erosion from P C to P T of curve. This, however, is not the case, as the writer has determined by soundings in many streams. There is always a point of maximum depth at a distance considerably in advance of the P C (beginning of curve); and if the curve is sharp, this maximum depth is found at a shorter distance from the P C than when the curve is flat. The chart given herewith shows this to be the case in the lower Mississippi.

As offering an explanation of this and all other phenomena of erosion and sedimentation at curves the writer presents the following theory:

When a stream of water reaches a curve, its upper strata having a greater velocity than those nearer the bottom, will develop a greater centrifugal force and consequently move toward the outside of the curve with a greater velocity than that with which the lower strata tend to move in the same direction. But in an open channel a general movement of the upper strata toward the bank cannot take place without a movement of the lower strata in a reverse direction and the velocity of this reverse movement will be $\left[\frac{VM - vm}{M + m}\right]$ in which V is the velocity due to the centrifugal force of the upper strata whose mass is M, and v is the centrifugal velocity of the lower strata whose mass is m. The upper strata will therefore move toward the concave bank, striking which they will be deflected downward and along the bank with a transverse velocity far in excess of the longitudinal velocity of the filaments of water flowing parallel with the bank and adjacent thereto. Since the stream has a forward as well as a transverse motion, the resultant is a progressive twisting motion, producing a remarkable scour of the concave bank and the bottom. The eroded particles will be carried to the opposite bank, but when the current begins to ascend that bank these particles will be dropped, as the current will not have sufficient force to lift a particle vertically that it could just roll along horizontally. We see therefore that it is not a decrease of velocity of the transverse current but a change in its direction that causes sedimentation at the convex side of the river bend. Our theory differs from Prof. Thomson's in recognizing the difference in centrifugal force of the different strata, and in attributing the transverse currents to head produced by this difference in centrifugal force and not to head produced by an inclined surface. Fig. 4 illustrates the motion of transverse currents according to the writer's theory.

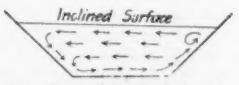


Fig. 3.—Diagram Illustrating Professor Thomson's Theory of the Erosion of Water at Bends.

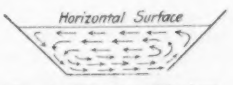


Fig. 4.—Diagram Illustrating Mr. Gillette's Theory of the Erosion of Water at Bends.

The great increase of erosion due to these transverse currents will be appreciated when it is remembered that the weight of a particle that a current will move horizontally varies approximately as the cube of the velocity of the current. There are several excellent objections to Prof. Thomson's theory besides the observed increase of scour at a distance beyond the P C, but it is not the purpose of the writer to attack any theory, but the commonly accepted one of increased tangential velocity at the concave surface of a river bend, which Prof. Haupt has so amazingly twisted.

Prof. Haupt says: "Neither velocity nor volume constitute the most important factors in erosion, but the impact due to concentrated currents." Another remarkable statement even if we admit the existence of "concentrated currents." Impact does not cause erosion. Impact is no more the cause of erosion than is pressure, to which the Russian authority quoted by Prof. Haupt attributes erosion at the bottom of the stream.

Contrary to Prof. Haupt's theory, erosion and sedimentation do vary with the velocity of a stratum of water and its direction of motion, as any mining engineer familiar with ore concentration by water currents can testify.

Having shown Prof. Haupt's theories to be false, it may well be asked whether his design of a curved jetty is not still good, for he expressly claims for it the merit of increasing the erosion along its face, which erosion will certainly occur regardless of theories. But let us ask when and where the erosion will cease, for if it does not cease within moderate depths, the curved jetty will be assuredly undermined and destroyed. Railway engineers who have had experience in maintaining pile abutments of bridges built on bends of rivers, need no argument to convince them that the maintenance of a curved jetty would be no simple matter. Prof. Haupt's jetty would be in part built upon a bar where the water is now only 10 ft. deep; but the scour after the jetty is completed may reasonably be expected to extend to a depth of at least 70 ft.; for a depth greater than this has been attained with curves of less radius, as shown in the accompanying diagram. What would happen to Prof. Haupt's jetty under such conditions? Inevitable failure by undermining, unless protected by ever-increasing amounts of rip-rap or brush mattresses until the single curve jetty advocated by him would attain a cost of more than the two jetties designed by the government engineers. There is in fact no assurance that scour would cease at a depth of 70 ft., and on the contrary there is every probability that the scour would attain greater depths due to the fact that the velocity of the transverse currents would be greater when they reached the bottom on account of not having exhausted any of their force in communicating velocity to eroded particles from a bank protected by rip-rap. Prof. Haupt naively remarks: "It is not the purpose of this paper to consider the details nor cost of construction." What, may we ask, is the value of any such plan as Prof. Haupt's if it is not proved to be cheaper not only in first cost, but in maintenance? This Prof. Haupt has not shown to be the merit of his design, and this it will be impossible for him to show. Maintenance is frequently a far more serious item than first cost, and as we have indicated this would be the case with Prof. Haupt's "reaction jetty," wherein the "reaction" would likely be against the further construction of such jetties.

It may be argued that the narrowing of the channel proposed by the Board of Engineers would have the effect of undermining the parallel jetties to an equal extent. Such would not be the case, for while the narrowing at the bottle neck would increase the mean velocity of the stream, it would not cause a corresponding increase in the velocity of the water filaments adjacent to the banks, but an increase varying as the square root of the increase in mean velocity, consequently undermining would occur to a less degree and to a less depth than with a curved jetty. Even were an equal increase in the velocity of the filaments at the sides effected, their velocity would still be many times less than that of the transverse currents generated by centrifugal force.

We are forced to conclude that since the board of judges at the Paris Exposition "has seen fit to award" Prof. Haupt "the gold medal in recognition of the novelty and utility" of his jetty, they may well proceed to prepare a diamond medal for the engineer who will maintain the jetty when once constructed.

H. P. Gillette.

751 Powers Block, Rochester, N. Y., Oct. 16, 1900.

(In accordance with our usual custom in the case of criticisms offered of articles previously published, we submitted a proof of the above letter to Prof. Haupt, and append his reply.—Ed.)

Sir: Your courteous favor of the 18th inst., enclosing a proof of a criticism of a paper on the "Improvement of the Southwest Pass," is received with thanks. Its author seems to labor under some confusion as to the meaning of words, and after attempting to state what he construes to be the writer's theory by quoting a probable physical condition due to change in direction and velocity or cross-section, he asks: "How can water be compressed?" It should not be necessary to explain to an engineer of standing that the term "compression" as applied to currents is used in an engineering sense, to imply pressure as distinguished from tension. The currents are pushed over from their natural path to a new channel instead of being drawn over by a different form of structure. The writer does mean precisely what he says, taking the words in their popular sense, and he has been misunderstood apparently by none of the many hydraulic or other engineers who have carefully read his papers, as well as many distinguished laymen.

As your correspondent states that the proposed curved jetty does not cut off or reduce the area of escape to one-third of its natural section and asserts that it cannot be shown to do so, it would seem useless to attempt, in view of his assertion, to make such demonstration, but if he will take a planimeter and apply it to the cut on the folding plate he will find the facts to be as stated and that it is quite as practicable to do this as it would be to reduce the bung-hole of a barrel by a plug which would stop up two-thirds of the aperture. It is also evident that more water can be made to pass through a given cross-section merely by increasing the mean velocity of discharge; also that the locus of the axis may be shifted by a change in the form of the cross-section.

Your correspondent next perverts the writer's statements as to the action of the currents in concave bends, and makes this a pretext for discussing the views of Prof. Thomson as derived from experiments on a current of rectangular section to which he also takes exception. His statement of observed facts, however, as to variable depth in bends and lateral movements of bottom material, due to the head and the helical motion of the particles of water, are correct and accord with the statements of the writer; and these are the phenomena which it is proposed to utilize. He has also noticed that the position of the deep water, at the point of greatest reaction, varies with the radii of the curve and states a well recognized fact that the reverse currents at the bottom are due to the head generated by the centrifugal force operating upon those at the surface as though it were a new theory or law. He adds: "impact does not cause erosion," etc., which is a remarkable assertion as coming from one who seems to have had some experience in hydraulic mining, or who has witnessed the action of impinging currents on a caving bank on the Mississippi.

"Having shown Prof. Haupt's theories to be false," by the mere assertion of opinions and distortions, but without citing a single fact, he then proceeds to condemn the plans based upon these theories, and says that while the jetty would be but 10 ft. deep, the scour to be expected

therefrom (although "impact does not cause erosion") would extend to depths of 70 ft., thus virtually admitting the truth of the entire argument, viz., that a concave jetty would remove material to a great depth and transport it laterally to the opposite bank; but he evidently does not seem to consider it possible to maintain such a bank, evidently ignoring the fact that it is one which is carved out by the river and which will maintain its equilibrium after the channel is once completed with comparatively little assistance from art, by means well known and successfully applied in practice. The depth to which scour extends is a function of the radius of curvature and can therefore be adjusted, in advance, to produce the desired depth under given conditions so that the structure, if well designed and placed, need not involve its self-destruction. If the curve of 4.43 miles radius will cut to depths of over "70 ft." by increasing the radius the depths may be correspondingly diminished to 60, 50, 40 or other dimensions and, carrying this mathematical truth to its limit, a radius of infinity will produce a straight jetty with no erosive capacity. Hence a single right-line jetty would be inert so far as scour by reaction occurs if its axis is parallel with that of the current. The fact is also overlooked that the plan does contemplate an ample rip-rap revetment of the eroded slope.

The inconsistencies of your correspondent are further shown when he says the "reaction" would evidently destroy the jetty while above he states that impact of a force produces no erosion; also, "Contrary to Prof. Haupt's theory, erosion and sedimentation do vary with the velocity of a stratum of water and its direction of motion." This is merely another illustration of the loose perversions that characterize this communication, since the writer nowhere makes such a statement; but what was said was that "neither velocity nor volume constitute the most important factors in erosion, etc." This fact may be illustrated at the Narrows of New York Bay, where the mean velocity is wholly inadequate to scour to depths of 102 ft. and carry sediment up a slope 60 ft. high to the bed of the upper bay. There are evidently quite a number of facts which your correspondent has not yet learned which may modify his philosophy in time.

But after all is said perhaps it may suffice to call his attention to the fact that an incomplete reaction breakwater built on the Texas coast about five years ago has produced a progressive deepening in the face of a serious obstruction across the channel so that it has removed the bar at Aransas Pass, without dredging, until there is a continuous depth of 15 ft at M. L. W., with maximum depths of 25 ft., while the 18-ft. contours are drawing closer together; the bar has not advanced seaward, perceptibly, and a natural spit on the convex side of the channel has formed to protect it from S. and S. W. winds. Concerning this breakwater a resident engineer recently said: "You need have no fears about the breakwater. It will speak for itself."

The cost has been a mere bagatelle as compared with the conventional plan of twin jetties, supplemented by dredging, and it is a complete answer to the objections raised in the article you have kindly submitted and which is based evidently on the alleged theories of its writer.

Not content, however, with a denunciation of the plans and structure of "Prof. Haupt" he must needs condemn a body of disinterested expert jurors for having recognized any merit in these plans and expresses the hope that a diamond medal may be awarded for the maintenance of the jetty if ever built. As the work at Aransas has maintained itself, with comparatively little settlement, for about 5 years, without a dollar of expense, although exposed to the full force of the sea and to rapid "undermining" currents, it would be a sinecure for the engineer who may receive so great an award for so insignificant a service.

The author should have quoted "Prof. Haupt" in full and not in fragments to illustrate accurately his plans and purposes, for half truths are misleading; but this review is already too extended, suffice it to say that your correspondent, although apparently condemning both the theory and practice, has accurately described, in his own way, the helicoidal or boring action of currents traversing bends, their great efficiency in eroding sediment and carrying it laterally to the opposite bank, but lower down stream, thus building up a natural levee, and the certainty that if the curve is carefully adjusted to the regimen of the stream an ample channel may be secured for all purposes of navigation. As to durability and cost of such work, it is believed that the writer has given them due consideration and feels that he is quite able to meet the demands in both of these important matters. The writer's thanks are due to your contributor therefore for the practical endorsement thus publicly given to his plans and methods, even though he appears not to understand "Prof. Haupt" nor his theories and has not correctly stated them.

Very respectfuly yours, Lewis M. Haupt.

107 No. 35th St., Philadelphia, Oct. 20, 1900.

NOTES FROM THE ENGINEERING SCHOOLS.

Dartmouth College.—Mr. J. Shirley Eaton, Statistician of the Lehigh Valley R. R. Co., has been engaged to give a course of lectures during January before the students of the Tuck School of Dartmouth College upon the "Theory and Practice of Railroad Statistics." The course will include a general discussion of railroad revenue and expenditure, followed by a detailed study of freight and ticket accounts and statistics, operating statistics, store requisitions, car accounting, and the general books, such as balance sheet, various journals, side ledgers, and accounts and reports of the Superintendent's office, and of the Master Mechanic and the Division Engineer.

Massachusetts Institute of Technology.—The formal inauguration of Dr. Henry S. Pritchett, former Chief of the United States Coast and Geodetic Survey, as President of the Massachusetts Institute of Technology, took place on Oct. 24, in the new Symphony Hall in Boston. A distinguished company was present, consisting of representatives of colleges and universities from all parts of the country and of the alumni. The entire main body of the hall was filled by the students, 1,250 or more in number Brief addresses were made by Senator Henry Cabot Lodge, by Col. Thomas L. Livermore on behalf of the Corporation, and by former President Crafts. The principal feature, however, was the inaugural address of the incoming President. Dr. Pritchett's practical experience as director of perhaps the most important purely scientific branch of the Government service rendered his inaugural address upon "The Relation of Educated Men to the State" peculiarly suggestive. His insistance upon the obligations of the institutions of higher learning to maintain about themselves an atmosphere favorable to the growth of a wholesome type of civic virtue is especially appropriate and inspiring, coming, as it happens, upon the eve of a national election.

Dr. Pritchett explained that for some years past, as an executive officer of the general government, he had been obliged to study the graduates of colleges and of technical schools from the standpoint of their efficiency in comparison with other men, rather than from the standpoint of the teacher; from the standpoint of their ability to do things rather than from the standpoint of knowing how to do things. In this capacity he had been forced to consider the relation of educated men to the government, to compare their service to it with the service rendered by others. He called attention to the fact that a constantly growing proportion of the important places of the government are passing into the hands of college men, and he asked the question whether the training received in our institutions of higher learning merely gave men increased power or did the college life also fit men for patriotic and loyal and unselfish service to the state? In considering this question he called attention to the fact that the state represents the whole people, that in this capacity it had given generously to higher education, both through the general government in the form of land grants and through the state governments by direct taxation. Even our older universities like Harvard and Yale have at some time, almost without exception, received aid from the state. Harvard was really founded by the Commonwealth of Massachusetts. The state has, therefore, the right to ask what sort of instruction is being given in our higher institutions, and to know that in these institutions men are trained in high ideals of their civic duties.

While maintaining that, on the whole, the institutions for higher education had justified the aid which they had received from the state, President Pritchett brought forward certain qualities of education upon which he conceived the state had a right to insist, and which had not always been remembered. "The state," said he, "has a right to expect of those educated in a large measure by its aid, a decent respect for the service of the state." He deprecated the widespread tendency to belittle government service, and to ascribe lightly the worst motives to public men. "The Government of the United States," he said, "is honestly conducted, and notwithstanding the crudeness of some legislation, and the half-hearted service of a few, those who know best the machinery of the general government have a rational optimism concerning the success of democratic institutions and a wholesome respect for those who work in public service. Educated men will find in increasing numbers their best career in the state's service, and college men should be the last to misunderstand and belittle it." Another quality of the education given to the youth upon which the state has a right to insist is its catholicity. "No system of education," said he, "is a good one in which students and graduates get out of touch with the great body of their fellow citizens. The higher institutions of learning, if they are to fill their real place, must be not only for the people, but of the people."

Beyond all such considerations, however, and including them all, is the quality of citizenship which our education is likely to produce, and what education ought to mean. President Pritchett referred to the literature of the subject, quoting Aristotle's summary: "What is education, and how are we to teach, and are we to aim at the development of the intellect or the moral character?" He called attention to the fact that the whole aim of modern education was the attainment of power, and to this end the intellect alone was considered in the training given to young men. He said that the state was interested in having in its service, keen, efficient, intellectual men, but that it was still more interested in finding men of courage and patriotism and unselfishness. In other words, in the service of the state, if not indeed in all service, character counted for more than intellect, and unless the training of the colleges and of the universities produced men who were not only intellectually able, but who were also strong in civic virtue, they fell short of their full duty. "The men who graduate from our higher institutions should, along with the training of their minds, grow into some sort of appreciation of their duties to the state; and they should come to know that courage and patriotism and devotion rank higher in this world's service than scholarly finish and brilliant intellectual power."

President Pritchett then took up in the light of these remarks the character of the training which comes from the study of applied science, and called attention to the wise foresight of President Rogers and his associates in estimating the value of a scientific training, not only as a fitting for practical life, but also in its development of character. In closing, as he turned to address the great body of students occupying the central portion of the great hall, they rose as one man and remained standing during the five minutes of the President's personal appeal to them. The impressive appearance of this body of young men, 1,250 strong, was one of the features of the occasion. —G. F. S.

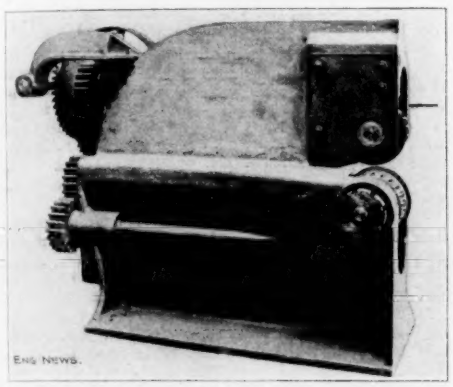
University of Mississippi.—The University has established a new department of Civil and Electrical Engineering, and is installing an extensive electric lighting, steam heating and power plant.

Cornell University.—The plans for the new hydraulic laboratory have been finished, and the work of blasting away the cliff overhanging the old building is about completed. The new building will rise 80 ft. above the roof of the old one. It will have a main floor space of 70 × 30 ft., and a wing 50 × 30 ft., and there will be five stories. The cost is estimated at $8,000.

The College of Forestry has made its second annual report. The Director is Mr. B. E. Fernow, who reports 17 students taking the regular course, or, including other students of the University who have attended special courses, 45 students in all, have been benefited by the establishment of the college. The College of Architecture has made the course on timber physics obligatory; and the College of Agriculture requires a course in silviculture. On March 1, 1899, the trustees of Cornell University took charge of the college forest, purchased for $165,000, under the terms of a law passed by the New York legislature in 1898. This forest is in the Adirondacks, and the property has been surveyed and mapped, some roads have been built, account of timber stock taken, buildings have been erected, and 50 acres have been planted with varieties of pine at the rate of about 1,200 plants to the acre. A nursery for trees has also been established at Axton. Of the annual appropriation of $30,000, a balance of $11,813.02 remained on hand.

A NEW ROTARY SPLITTING SHEAR.

The plate shear illustrated in the accompanying cut is designed to do the work of cutting and trimming iron and steel plate much faster than the ordinary form of alligator shears, and with less manual help than the latter machine requires. The two rotary cutters are set one above the other in the jaw of the heavy frame, and are vertically adjustable to fit the thickness of plate to be sheared. Each cutter is set on a worm wheel 12 ins. diameter and 7 ins. wide, driven by a worm 7 ins. in diameter on the end of a horizontal shaft parallel with the frame. The worm wheels are seen in the cut. These shafts are located in the lower and upper part of the frame and so arranged as not to interfere with the cutting or handling of the plate during the process of shearing. At the outer end of each shaft is a pinion gearing with an idler pinion of the same size, and all driven by a spur pinion cast on the back of a 24-in. bevel wheel. The latter is driven by a bevel pinion set on the shaft of the 28-in. belt pulley, which carries a 6-in. belt. The floor space required is only $6 \times 2\frac{1}{2}$ ft., while the length at the top is 4 ft. The driving mechanism is so arranged that the belt can be run direct from the main line shaft and the machine placed in line with all the others in the shop, the same as the ordinary "alligator" splitting shear, an arrangement which, it is claimed, is not possible with any other rotary



Rotary Splitting Shear for Iron and Steel Plate.
Scully Steel & Iron Co., Chicago, Makers.

shear except at additional cost. The machine feeds itself after the plate is once fed into the cutters, so that with the use of a trolley one man can easily guide the plate along the cutting line and obtain a straight, clean cut, where otherwise it would be necessary for three or four men to be employed. The machine will cut plate any width or length, as heavy as ¾-in. thick and as light as No. 16 gage, and in making a test the shears cut 7 ft. of ¾-in. plate in one minute. The plate passes along the shelf of the frame, being turned to a vertical position and diverted to one side as it approaches the gearing at the end. A distinguishing advantage of this machine is that by its use it is possible to follow a convex curved line with a fairly small radius. The knives can be reversed and used on either side, thus prolonging the life of the cutters and permitting the full use of both sides before they need to be redressed.

This machine was designed by Mr. Charles Kling, of Kling Bros., and patents have been applied for. It is manufactured by the Scully Steel & Iron Co., 136 Fulton St., Chicago, and we are indebted to the makers for photographs and other information.

THE POLLUTION OF PUBLIC WATER SUPPLIES IN THE UNITED STATES.*

Since 1894 your Committee on the Pollution of Public Water Supplies has devoted most of its efforts to matters of an analytical nature. From the beginnings then made, and with the aid of a large number of laboratory workers, there have resulted the publication of a Report on Bacteriological Methods, which is widely used in this country and well thought of abroad, and the establishment of a Section of Bacteriology and Chemistry. The analytical phases of water pollution problems having been delegated to committees under this section, the present committee returns to topics of a more general nature.

It was decided by this committee that, for the present meeting at least, our report should take the form of records and summaries showing recent progress in the more important branches of the subject assigned to us. Accordingly, a series of topics was allotted to the individual members for the preparation of the available evidence; and the general report presented herewith consists of a summary of the material accumulated in this manner.

The president and secretary of the association requested this committee to take steps to bring out a thorough discussion of this general subject from the standpoint of the engineer, the analyst and the health officer. This request has been complied with so far as practicable.

I.—WHAT CONSTITUTES A SATISFACTORY WATER SUPPLY IN THE LIGHT OF OUR PRESENT KNOWLEDGE?

Expressing in brief terms the leading features of Mr. R. S. Weston's paper, it may be said that the modern water supply must provide under adequate pressure a sufficient quantity to meet liberally all legitimate use and unavoidable waste, of water which is either originally pure and wholesome, or which has been rendered so by some process of purification. With regard to quality, the water supply of the future should meet the following requirements:

(a) It shall be free, or substantially free, from disease producing germs.

(b) It shall be clear and colorless, or very nearly so, containing no objectionable turbidity or vegetable stain.

(c) It shall be free from objectionable tastes and odors as supplied to the consumer.

(d) It shall be free from noticeable amounts of dissolved iron, such as unfit it for household use.

(e) It shall be free from excessive amounts of lime and magnesia, such as make a water too hard for ordinary use.

(f) It shall be carefully examined with regard to constituents capable of dissolving metals used in distributing pipes, and this information in connection with the pipes employed should result in such steps as necessary being taken to guard against complications of this nature.

To many of you these brief facts will seem very trite. It will appear that they represent what has been sought by the foremost sanitarians and water-works men for years, and, if not obtained in practice, it has been because the actual results accomplished in many places have been limited by financial or other important local considerations. In a measure your committee recognizes this fact, but it desires at the same time to point out that recently there has been a marked change in public opinion in this respect. Many water supplies which were apparently satisfactory ten or fifteen years ago are unsatisfactory to-day; and there are supplies which are claimed by municipalities to be suitable now which will not be so ten years hence.

In presenting to-day for your consideration and discussion a progress report upon this important topic, it is not the desire of this committee to see the time occupied in an exact definition or specification of the ideal or thoroughly satisfactory water supply. This general information is so well known to you all that further details are unnecessary. It is the hope and intention of the committee, however, to see the discussion focus upon the actual issue of the day, namely: How nearly must the future water supply approach the ideal in point of quality, in order to satisfy the modern water consumer, and what are the recent advances which have been made towards securing this end?

It is very gratifying to be able to state that very substantial progress has been made since a general survey of this topic was last made to the association. The progress may be divided into two distinct classes. The first relates to changes in public opinion as to the character of water which consumers are entitled to receive. The second is connected with improvements in physical processes necessary to satisfy the demands of the more intelligent citizens.

At the present time there is a considerable portion of the inhabitants of the various centers of population which recognizes clearly that they are entitled to a water supply which shall not transmit to them water-borne diseases. A smaller proportion of water consumers, but aggregating numbers far greater than most people realize, considers that a water supply should also present a first-class appearance with regard to freedom from turbidity and discoloration from iron and vegetable stains. In support of this advance in public opinion, it is only necessary to point to the fact that within the past 10 years, over 40 of the larger American cities have given active consideration to the improvement of their water supplies, chiefly on the ground of quality. Another fact which speaks volumes in itself is the growing custom among the better class of water consumers of attempting to improve the quality and appearance of the supply by the purchase of water from peddlers, or by household filters, or both. When this rapidly-growing class of water consumers reaches an effective majority in their respective communities is the time when it will be imperative that the quality of water supplies shall equal or approach very nearly to the ideal, as noted above. The present trend of affairs, however, indicates that in a great many instances this date will be discounted by water-works officials in their desire to maintain public works in touch with the best thought of the times.

Until quite recently water-works officials answered criticisms concerning the quality of their supplies by the legitimate statement that it was impracticable for them to secure a supply which in its natural condition was perfectly satisfactory, and that there was not enough information concerning purification processes as to cost and efficiency to justify large expenditures. The truth and significance of this statement with reference to supplies of unpolluted, clear and colorless water will increase each year. With regard to methods of water purification, the day has gone by when this statement alone can properly be made. While the original water should be as free from sewage pollution as practicable, it may be definitely stated that it is now possible after study of local conditions to purify almost any water in a satisfactory manner, and at a reasonable cost, although some waters are so bad as to make their use inadvisable when other supplies can be found. The special field of water purification is discussed beyond. But it may be added here that the total cost of purification ranges ordinarily under different local conditions, only from about 20 to 50 cents per capita per annum, a mere fraction of the cost of spring water and other waters now freely bought from private sources. The range in cost is largely due to differences in the amount of water which is illegitimately wasted. In fact, the needlessly large consumption of water in most American cities is one of the chief drawbacks to improvement of the quality; and the sooner public opinion assists in restricting the waste, the sooner will the consumers have better water.

In brief terms it may be said that the current evidence indicates that as a general rule the surface waters for the future supplies of this country should be taken from as unpolluted sources as practicable and should be properly purified (including clarification and decolorization); that excessively hard waters should be softened; and that ground waters should be freed from dissolved iron if present beyond slight amounts.

II.—ON THE VALUE OF VITAL STATISTICS AS AN INDEX TO THE POLLUTION OF WATER SUPPLIES.

Twenty years ago it was considered that the chemist, after making a few analyses, could render a positive and unqualified decision as to the hygienic character of any water. In making his decision he was usually aided more or less by a series of arbitrary standards of purity, based on evidence from a limited number of types of water. With the advent of the germ theory of disease and the new science of bacteriology, the position of the water chemist became less autocratic. There followed a period of doubt in the minds of many, due in part to the added knowledge coming from a wide range in the types of natural waters.

At present it is to be stated that the modern water analyst should be skillful in the application of both chemistry and biology. Apart from the very important role which he is destined to play in the future with reference to purification processes, it may now be said that, after he has secured the needed analytical data, he can tell definitely whether the quality of a given water for domestic use is very good or very bad. With regard to that large intermediate class, conventionally called "suspicious" waters, and which may be used with moderate safety for years, or which, without warning, may cause a typhoid fever epidemic at any time, the position of the analyst is far less sharply defined.

Leading sanitarians agree concerning suspicious waters that, while the work of the analyst is very important, final conclusions should be based not on his data alone, but in conjunction with the results from sanitary surveys of the source of supply and with the vital statistics of the water consumers.

The value of vital statistics in this connection is clearly stated in the paper by Dr. A. C. Abbott, who concludes that "of the data relating to suspicious water supplies, that which is most trustworthy and constant in its indications are the regularly recorded vital statistics of the community using such water."

III.—COMPARATIVE STATUS OF THE WATER SUPPLIES OF THE LEADING AMERICAN CITIES, AS SHOWN BY TYPHOID FEVER STATISTICS FOR THE LAST TEN YEARS.

These valuable data are frequently sought for by sanitarians in connection with various studies. Although many of the records have been compiled in various publications, it is usually difficult in many instances to bring them up to date without considerable time and labor. It is thought by the committee that it would be well to establish the custom of including in our reports each year complete records as a matter of reference, of typhoid fever rates for leading cities from 1890 up to the current year, as far as practicable.

This time-consuming task has been undertaken for the committee by Mr. J. J. MacKenzie, who sent out circular letters to secure these data for all cities of over 10,000 population. This information in satisfactory form has

*Report of a Committee of the American Public Health Association presented at the Indianapolis meeting, Oct. 24, 1900. Geo. W. Fuller, Assoc. M. Am. Soc. C. E., Chairman Committee, 220 Broadway, New York city.

been obtained for the cities in the States of Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Ohio and Michigan, as well as for quite a number of the larger cities in other states. Delay in securing the returns of the recent census makes it impracticable to present this evidence to-day, although it will be in readiness to be included in the forthcoming annual publication of the association.

IV.—ON THE CONSERVATION AND CONTROL OF WATER SUPPLIES BY STATE, PROVINCIAL AND MUNICIPAL AUTHORITIES.

This general topic is a very broad one, and one of the most important coming before the association for consideration. Under present arrangements there is some uncertainty as to how the subject had best receive the attention which it deserves. This is largely due to the fact that it relates to the work of several committees, notably that on Public Health Legislation.

To the thought of your Committee on the Pollution of Public Water Supplies, it would be very desirable to make this topic the subject of special discussion at the next meeting of the association, and it herewith makes recommendations to that effect. The most suitable manner in which such a discussion could be taken up is a question which requires attention.

This committee has devoted some time to the collection of evidence upon this subject, to serve as a matter of reference and also to facilitate discussion to-day and at your future meeting. The evidence, so far as it is available, is presented in the paper by Dr. F. F. Wesbrook.

V.—ON THE RELATION OF THE ANALYTICAL LABORATORY TO PROBLEMS IN THE POLLUTION OF PUBLIC WATER SUPPLIES.

Ten years ago the analytical laboratory for a number of reasons occupied a rather uncertain position with reference to water pollution problems. So far as systematic work was concerned, it was then confined largely to the labors of the State Boards of Health of Massachusetts and Connecticut, although analytical data on special problems were obtained by various authorities from time to time, and the water supplies of a few of the large cities were analyzed quite regularly.

Since 1890 there has been a rapid advance in the amount of analytical data secured each year, relative to problems in water supply and sewage disposal. This is especially true with regard to purification plants and processes and various special problems. At this time it is gratifying to note that there is a growing appreciation of the value of analytical data, and that the true position and scope of laboratory work is being more correctly understood. During the past ten years there have been established more than 20 new laboratories in this country, in which the analysis of water and sewage forms a prominent feature. Further, there is a growing number of state and local authorities which avail themselves frequently of private laboratories or those of educational institutions.

The details concerning the growth and present relation of the laboratory in this line of work will be presented by Dr. Wyatt Johnston.

VI.—ON THE LEGAL ASPECTS OF WATER POLLUTION.

Each year sees an addition to the accumulating evidence upon the legal aspects of water pollution. To many sanitarians and water-works men this is a subject which presents to them considerable interest from time to time. It is the intention of this committee, as time allows, to present in condensed form the leading features of the more prominent court decisions in this connection. The purpose of this will be principally for reference, rather than for detailed discussion.

Beginnings toward this end have already been made by Dr. J. L. Leal. At this time, however, there is little to be said, in the form of a summary, with regard to general progress in this direction.

VII.—SUMMARY CONCERNING SEWAGE PURIFICATION PLANTS NOW IN OPERATION IN AMERICA.

It appears that there are now in operation in America several hundred sewage purification plants, ranging in size from those for cities of more than 100,000 inhabitants down to those for small institutions and summer hotels. With regard to the larger ones the available information indicates that there are about 75 which treat the sewage of about 500 persons or more. Many of these plants were installed to reduce the pollution of public water supplies, while a large number are operated with the view to obviating nuisances, such as would arise from putrefactive changes in the bodies of water into which the effluents are discharged.

More or less information of a general nature concerning many of these plants is available, through official reports and articles in professional and technical journals. Detailed specific information upon various points of importance, however, is for the most part confined to the larger plants in Massachusetts, which have been studied by the Board of Health of that state. Compilations of the leading published information available from the larger plants have been made by your chairman, supplemented somewhat by personal inspection and by correspondence. While as yet the amount of directly comparable data is too meager to warrant a detailed presentation, yet these comparisons bring clearly to light a number of points of general interest and of suggestive value. Some of them will be noted, to facilitate your discussion to-day.

The point upon which our knowledge has been most advanced through data coming from sewage purification plants in actual practice, seems to be the composition of sewage. For years it has been known that the composition of all sewages varies widely at different times, and that American sewages are much more dilute than those abroad. It is the amount of suspended organic and mineral matters in a sewage which usually gives the best index to its composition with reference to purification. The reasons for this are that suspended mineral matter becomes a sludge which after greater or less accumulation requires removal by physical means at considerable expense; while the suspended organic matter is the chief factor of difficulty in processes for thorough purification, from the standpoint of both cost and efficiency. There are at least twelve places in this country where such information has been obtained with sufficient frequency to yield results which may be used as approximate averages. As a matter of reference, these results, taken from the reports of the State Boards of Health of Massachusetts and Connecticut, are given in the following table, beyond which are corresponding results from European sewages.

Record of Average Suspended Matters in Some American Sewages.

Parts per 1,000,000.

Places.	Years.	Total.	Mineral.	Organic.	*Per cent.
Brockton, Mass	'97-8	120	23	97	81
Chicago Exposition	'93	182	29	153	84
Framingham, Mass.	'93-8	1,304	154	1,210	89
Gardner, Mass	'92-8	134	31	103	77
Lawrence, Mass	'88-9	240	102	138	51
Leicester, Mass	'97-8	106	25	81	77
Marlboro, Mass	'92-8	201	53	148	74
Medfield, Mass	'94-8	107	26	81	76
Meriden, Conn	'97-8	120	38	82	68
Natick, Mass	'97-8	23	12	11	45
Spencer, Mass	'98	95	13	82	87
Worcester, Mass.	93-4	212	99	113	53
Total average	——	242	50	192	79
Total average, except Framingham	——	140	41	99	71

*Which organic is of total.

Record of Average Suspended Matters in Some European Sewages.

Parts per 1,000,000.

Place.	Authority.	Total.	Mineral.	Organic.	*Per cent.
Average, 16 English water-closet towns.	(†) ..	447	242	203	46
London, '94	Dibden	450	...	...	..
Sutton, '99	Rideal.....	609	...	...	..
Leeds,	City Doc'mt....	331	...	...	..
Accrington, '99	Naylor	505	205	300	59
Danzig	Koenig.....	582	226	356	60
Berlin,	Koenig.....	1,085	383	702	65
Breslau,	Koenig.....	405	205	200	49
Haller,	Koenig.....	594	189	405	68
Frankfurt,	Koenig.....	1,193	387	806	67
Leicester, '98-9	City Doc'mt ...	624	...	...	..
Salford, '92	Vogel.....	512	144	368	72
Cassel,	Hoopner and Paulmann ..	5,400	1,246	4,214	78

*Which average is of total. †River Pollution Com.

With regard to the fundamental principles which control the operation of plants in practice for the purification of sewage by irrigation or intermittent filtration, the most comprehensive statement which can now be made is to the effect that the available evidence, so far as it goes, testifies to the soundness of the laws which were formulated at the Lawrence Experiment Station. In fact, there are some indications that somewhat better results may be expected in practice than have been obtained from the experimental filters, other things being equal.

For a high degree of purification of sewage entering small, short feeders to public water supplies, there is no evidence to indicate that this can be accomplished in a better manner than by intermittent filtration. The cost of this treatment depends largely upon local conditions. Where ample areas of suitable land are readily available at a low cost, as is the case in many places in New England, first-class results can be obtained at the least cost by this method in its simplest form. But where suitable land is very scarce and expensive, or where filters would have to be built of selected material brought from a distance, the indications are that economy demands that the sewage receive a preliminary treatment, so as to allow of higher rates of filtration. Such preliminary treatment relates of course to clarification of the crude sewage, or, in other words, to the removal of the suspended matters which exert such a troublesome clogging at the surface of the filters.

Much study for many years has been given to the clarification of sewage as a preliminary step in its purification, and the problem is still an open question. During the past few years the so-called septic tank system has been much talked about in this connection. Although this procedure is being tried on a greater or less scale at 10 or 11 different places in this country, comparatively little is now known in definite terms concerning its practicability under various known conditions as to the sewage treated and details of devices employed. Opinion as to its merits is widely at variance. Some very erroneously appear to regard it as a complete purification process by itself, and a successful solution of the difficulty of final disposition of matters suspended in sewage. Others seem to question its practicability on the basis that there will be a large accumulation of sludge in the septic tank, involving much expense for its removal as well as nuisances due to bad odors.

Whatever the future may show to be the true merits of the septic tank. It is certain that it can never afford a final disposition for the suspended mineral matter in the sewage. This is a point of much significance, as the mineral matters form from 20 to 40%, and sometimes 50% of the solids in suspension.

With regard to filtration of sewage at comparatively high rates, to secure moderate purification for cases where the effluents are very indirectly or not at all connected with public water supplies, there is very little evidence from actual operations in this country. In general terms, it would appear that success in this important field will be associated to a considerable degree with the freedom from suspended matters in the sewage as it reaches such filters. It is felt that much more information is needed in this branch of work before large plants can be built with confidence as to permanency and economy.

IX.—ON THE PRESENT STATUS OF METHODS OF PURIFICATION OF WATER SUPPLIES, WITH A SUMMARY OF PLANTS IN OPERATION IN AMERICA.

Of the various branches of public works connected with the pollution of water supplies, there is none in which such substantial progress has recently been made as in water purification. Ten years ago our information upon this subject was very meager, and comparatively few plants were in operation. During this period English sand filter plants have been increased from about 1.5 to 19 acres, with respective nominal capacities of about 4,000,000 and 37,000,000 gallons daily; and the American, or mechanical filter plants have been increased from about 12,000 to 90,000 sq. ft., with respective nominal capacities of about 36,000,000 and 270,000,000 gallons daily. Projected plants for some of the largest cities in the country show that in the next few years there will be very rapid development in the application of both of the leading methods of purification.

Concerning the large fund of technical knowledge relative to the efficiency and cost of water purification which is readily available from various books, reports and professional and technical journals, it is needless to touch upon them in this report of progress. An adequate statement of the general situation at this time will be found in the paper by Mr. Allen Hazen. With regard to the leading generalization which can be made at this time, leading workers in this subject agree upon the following:

(1) Of the various processes mentioned for the purification of water supplies, there are two general methods which have shown distinctly their practicability, namely, the English method of slow sand filtration and the American method, employing rapid mechanical filters.

(2) Each of these methods has its distinct advantages for particular cases, as well as its disadvantages for others; and there is no doubt that each has a large field of usefulness.

(3) For those waters which never possess more than a slight or moderate amount of turbidity or dissolved vegetable color, the English method of sand filtration is somewhat more efficient; and as a rule it is slightly the cheaper for such waters.

(4) For those waters which for long periods at a time contain excessive quantities of either finely divided clay or of dissolved vegetable matter, there is now no practicable method of purification without the use of coagulents and subsiding basins. It is the concensus of opinion, however, that coagulants should not be employed where it is practicable to secure satisfactory results without them.

(5) While coagulants can be successfully used in connection with the English method of sand filtration, in those cases where coagulants are imperative, the American methods as a rule yields somewhat more efficient and economical results.

(6) Many of the purification plants now in operation in this country have not shown as high efficiency as is reached by some of the better ones, and as may be expected from those now about to be built. This is due in part to their construction, and in part to their management, the latter point applying particularly to mechanical filters.

(7) While there has been rapid progress in the past four years in discovering the controlling laws of purification and in the establishment of certain types of filters, there are indications which go to show that material progress and improvement may be expected for some time to come.

X.—CONCERNING RECENT PROGRESS IN EUROPE IN MATTERS PERTAINING TO THE POLLUTION OF PUBLIC WATER SUPPLIES.

This broad field is so well covered in the most important points through various reports, books, and journals available to the members of the association, and is so well known to many of you through recent visits abroad, that there is little to be said at this time by your committee.

Several members of this committee, however, have been interested in securing information relative to the present governmental control of water pollution in Europe, and the procedure employed in accomplishing practical results. A summary of this information will be reported upon at a future meeting.

With regard to water purification in Europe, the most striking feature is the efficient manner in which the plants are operated. This is due in part to the long experience,

with each particular water, of technically competent men; and in part to the scientific control and supervision both on the part of the water-works' officials and of other authorities.

European experience in water purification covers a much narrower range in types of water than has been carefully investigated in America, and can supplement but very little the leading evidence now available in this country. Concerning the purification of waters highly charged at times with algae and similar growths, the present evidence is almost wholly confined to European experience.

The subject which of course is of most interest to the greater part of American sanitarians relates to recent developments in England with septic tank and high rate filters in the purification of sewage. To a majority of Americans who have made personal inspections at leading English cities, it would appear that developments are rather disappointing, and still lacking in thoroughness in some essential features. To the thought of some of the foremost sanitary engineers in England it is yet too early to conclude that the past ten years have shown any substantial improvement in England in methods of sewage disposal. The majority of English sanitarians take a far more hopeful view than this, and consider that rapid progress has recently been made, especially in our knowledge of the underlying principles of bacterial purification. It is difficult, however, to ascertain in precise practical terms in just what this progress consists, in view of the widely varying types of procedures which have been projected for several of the larger English cities.

In this connection it is of interest to note the position of the Local Government Board. As many of you know, plans for sewage disposal are normally presented in England to this board for approval, in order to secure authority for the loans needed to cover the cost of construction of new works. While this board has approved a number of plans embodying new types of purification processes, it has in every instance, so far as we know, insisted that the loan be increased to cover cost of land treatment, to follow, if needed, treatment by the new processes. In the opinion of a majority of English sanitarians this qualification is needlessly burdensome. Notwithstanding, very recent developments indicate that the board will hold its position until it receives for its guidance the report of the Royal Commission appointed last year to investigate the new processes.

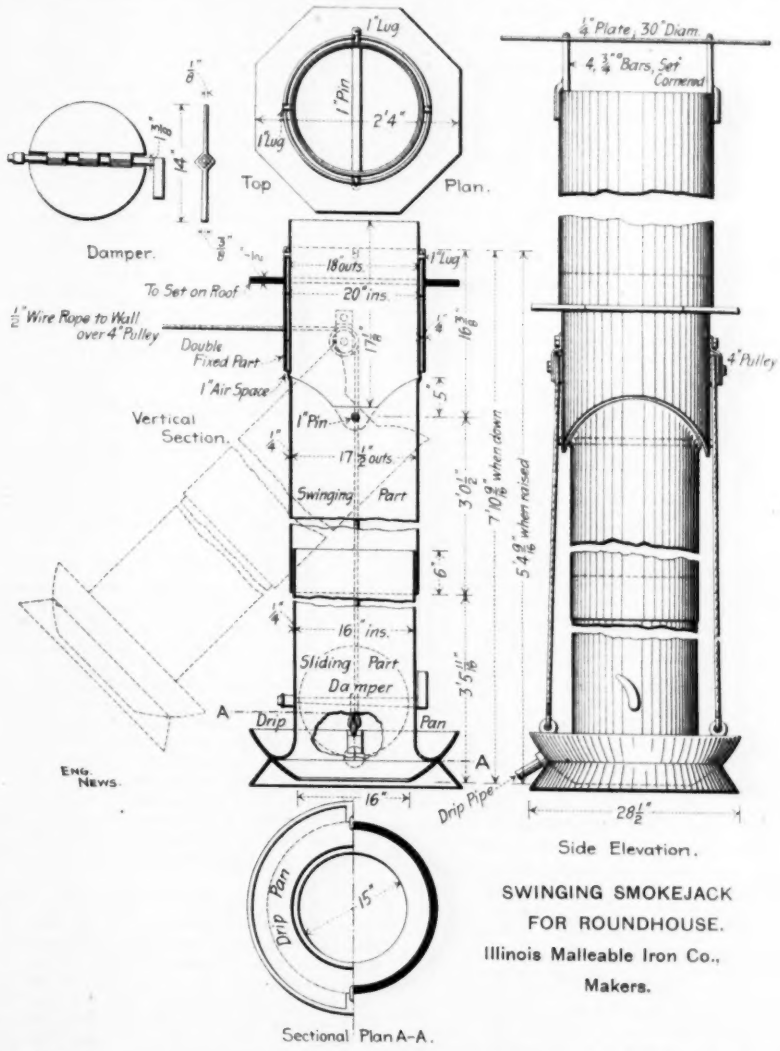
It is to be added that it is possible to circumvent the direct approval of the Local Government Board by means of a special act of Parliament, although the board still exerts its influence through committees. This procedure is expensive, and is prohibitive for this reason for the smaller cities. A number of the larger cities, however, are availing themselves of this step.

Summing up in brief terms the present English evidence upon new processes for sewage disposal, it may be said that while it shows many promising features, it is not yet sufficiently definite and exhaustive to allow final conclusions to be drawn.

A SWINGING SMOKEJACK FOR LOCOMOTIVE ROUNDHOUSES.

In roundhouse construction, a smokejack is placed over the end of each track, having usually a wide funnel mouth some distance above the level of the tops of the engine smokestacks. In some cases these are telescopic and drop over the smokestacks, but are then liable to be broken by the engines being moved before the jack is raised. The Bruyn smokejack, illustrated herewith, fits upon the top of the smokestack, forming a tall stack or chimney which gives a good natural draft when the engine fire is being lighted up, and prevents the escape of smoke and gas into the roundhouse or cab. The exclusion of the air and the direct draft also prevents condensation of vapor on the inside, which condensation often causes trouble by dripping on the engine. When an engine is cooling down, a damper in the base of the smokejack is automatically closed, thus preventing a down draft of cool air which would chill the tubes and tube sheet and tend to cause too rapid contraction. In winter, also, this damper prevents the escape of the warm air in the roundhouse, thus maintaining a more even temperature and reducing the fuel consumption for any system of heating.

It will be seen from the accompanying cut that the jack consists of three parts. The upper or fixed part extends below the roof and is cut away to allow of the movement of the swinging movement of the movable section, the middle or swinging part being pivoted to the fixed part by a 1-in. pin. At the bottom of the swinging part is the lower or sliding part, which fits it telescopically, making the height adjustable. Two ½-in. wire ropes are attached to the bottom of the sliding section, pass up and over 4-in. pulleys on the fixed section, and then across to pulleys on the wall, the ends carrying counterweights. The jack has an inside diameter of 16 ins. at the mouth, with a 14-in. disk damper just above the mouth. The thickness of metal in the damper is ⅛-in. on one side and ⅜-in. on the opposite side, as shown. The mouth of the jack has an annular trough to catch any moisture running down the outside of the jack, and has a drip pipe to carry off the accumulation. The suspension ropes permit the height of the jack to be adjusted to fit any engine, and if an engine should strike a jack or be moved before the jack is raised, the movable section would simply swing on its pin bearings, as shown by the dotted lines. This device is manufactured by the Illinois Malleable Iron Co., 30 W. Monroe St., Chicago, Ill.



SWINGING SMOKEJACK FOR ROUNDHOUSE.
Illinois Malleable Iron Co., Makers.

ANNUAL CONVENTION OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

The tenth annual convention of this association was held at St. Louis, Mo., Oct. 16, 17 and 18, the headquarters being at the Southern Hotel, where also the meetings were held. On Oct. 16, the meeting was called to order at 10 a. m. by the President, Mr. A. S. Markley (C. & E. Ill. Ry.). After prayer by Mr. J. H. Cummin (Long Island R. R.), an address of welcome was delivered by Mr. H. Smith, Attorney of the Wabash R. R., which was responded to by Mr. Cummin. The remainder of the morning session was occupied by routine business, including the roll call, admission of new members, payment of dues, presentation of annual reports of officers, and the appointment of committees. The report of the Secretary, Mr. S. F. Patterson (Boston & Maine R. R.), showed a present membership of 146, and recorded the deaths of C. S. Worden (Santa Fe Pacific Ry.) and G. W. Hinman (L. & N. R. R.). A complete set of the reports was sent to the Paris Exhibition. The receipts during the year amounted to $1,651, and the expenditures to $1,323, leaving a balance of $328. The report of the Treasurer, Mr. N. W. Thompson (P., Ft. W. & C. Ry.), showed a total balance on hand of $719.

The afternoon session was called to order about 2 p. m., and was opened by an address by Mr. Walter G. Berg, M. Am. Soc. C. E. (Ch. Engr. Lehigh Valley R. R.), on "The Education of Railway Men for Subordinate Positions of Responsibility, More Especially with Reference to Employees of the Bridge and Building Department." This paper was in general similar to one presented by Mr. Berg at the recent meeting of the Eastern Maintenance of Way Association, an abstract of which was given in our issue of Sept. 20. A special vote of thanks was tendered to Mr. Berg. The reports of the committees on technical subjects were then read, discussion upon them being reserved until a later session. Abstracts of three of these reports were given in our issue of Oct. 18. The others are given below, and for convenience of the reader we have added notes on the discussion in each case instead of reporting these in place in the second day's proceedings.

TOOLS FOR BRIDGE GANGS.

Bridge men have often not enough tools for the work required of them, and consequently work at a disadvantage, but while it is necessary to economize as much as possible in the equipment, it is difficult to determine just what is needed, as the work is so varying. As bridge gangs are on most roads expected to do all kinds of work, on iron and wooden bridges, at stock yards, station buildings and platforms, etc., the gangs should be equipped with a sufficient supply of tools to do any kind of its work without delay or disadvantage.

An itemized list of a complete equipment of tools accompanied the report. One member expressed doubts as to whether any bridge gang had such a complete equipment as this, but three or four others remarked that their gangs had even more complete equipments.

BEST FORM OF SNOW FENCE, STATIONARY OR PORTABLE.

An abstract of this report has already been given. In the discussion, the diagonal fences built down the slopes of the cuts (Eng. News, Nov. 30, 1899,) were referred to, but Mr. Pickering (Boston & Maine R. R.) stated that in his divison they have been removed. In mountainous country the wind is so broken up that there is no prevailing direction, while the tendency is to form bars of hard-packed snow across the track, which are more dangerous than an ordinary continuous drift in which the snow has not been packed by the force of the wind. The

use of glance fences was also referred to; these are set near the edge of the cut, inclined at an angle of 45°, with the bottom a few feet above the ground. The wind is thus diverted downward so as to scoop the snow out of the cut. Mr. Cummin (Long Island R. R.) thought this would be useless with narrow deep cuts. Mr. Killam (Intercolonial Ry.) has found permanent fences most satisfactory; no portable fences are now used and permanent fences have been substituted for some of the snowsheds.

TRACK SCALES.

Our circular of enquiry has brought 19 answers: 10 use the Fairbanks, 2 the Buffalo, 1 the Howe, and 2 make their own scales; 12 are in favor of the deck scale, and 1 in favor of suspended scale; 12 are in favor of using the dead rail, and 2 not in favor of using them; 4 in favor of long stands and 4 in favor of short stands; 2 use brick foundations; 9 stone, 1 piling, and 1 concrete; 2 test their scales every month, 2 every two months, 1 every three months, 2 every six months, and 3 once a year; 6 use a car for testing, and 4 use 4-ton weights. We will give you the opinion of the only friend of suspended scales: "At one point we have a suspended scale and two deck scales, all doing the same class of work. Some four years ago these scales were all renewed with scales of larger capacity. The suspended scales were in good condition, and had been in service for more than 20 years. The deck scales were in bad order, and had been in use less than half that time, also deck scales had to be looked after and cleaned much oftener than the suspended. In regard to the relative value of suspended and deck scales, our experience has been that suspended scales give more accurate weights, with much less care, and last twice as long. Against this is the smaller cost and less room taken by deck scales, when not housed." The opinion of the committee is, that if more of the members had had experience with suspended scales, they would have more friends. We took the pains to go and examine a first-class suspended scale. In its favor we found there was no chance of freezing, less friction to wear bearings, and if properly housed in, no chance of rust or corroding, and no chance of settlement in foundation. To offset this is the extra room for erecting a building, and the additional first cost. We differ with some of the members relative to using the long dead rail stand. As the longer your stand, the more leverage the load has in passing over the scales; the stands are more apt to break, and you have to use bridle rods to keep them from spreading, which in our judgment is a detriment. Where the dead rail is used, we would recommend having the dead rail the straight rail, so they will have to throw the switch to get on to the scale rail. We would also suggest the advisability of testing scales more often than some of the roads do. Scales should be tested at least once a month, whether you do any business or not, and scales at harbors and terminal points, or any scales that are used constantly, should be tested even oftener than that. We find some private firms that test their scales every Monday morning. We would also recommend using a test car instead of weights, as the scales may weigh a light load correctly, and have quite a variation in a heavy load. This is especially true if the bearing of the scales are dull. H. D. Cleaveland, William M. Clark, C. P. Austin, J. T. McIlwaine.

In the discussion, Mr. Wm. M. Clark spoke very strongly in favor of the suspended scale, an arrangement entirely unfamiliar to many of the members. The table is suspended by 24-ft. rods from scale beams overhead, carefully boxed in to exclude smoke and dust. Thus the longitudinal play of the table which causes so much wear of the knife-edge bearing points of deck scales is reduced to a minimum by the long rods, which act as pendulums.

IS CONCRETE THE MOST SUITABLE AND ECONOMICAL MATERIAL FOR BRIDGE PIERS AND ABUTMENTS AND RAILWAY CULVERTS AND ARCHES.

This voluminous report was prepared by a "committee" of one, namely, Mr. W. A. Rogers (C., M. & St. P. Ry.), and has already been given in abstract in our issue of Oct. 18.

The discussion showed that the author had dealt with a subject of special interest to all the members, and for over an hour Mr. Rogers was bombarded with enquiries for still further information on several matters of detail. Mr. Manning (Mo., Kan. & Tex. Ry.) is using rubble concrete, with large blocks of stone, leaving 4 to 6 ins. between the blocks and between the blocks and the face of the work. He is also experimenting with concrete composed of gravel and of burnt clay in place of broken stone. He uses a box mixer of his own design, the water being admitted through a hollow shaft in measured quantities, so that the concrete can be made of any desired consistency. All the mixing is done by machine, and the amount of water is usually 22 gallons per cu. yd. of concrete. Mr. Schall (Lehigh Valley R. R.) had tried the continuous mixing system, and had found it unsatisfactory; the concrete is not of uniform quality, being sometimes too wet, at other times too dry. Mr. Eggleston (Erie R. R.) spoke of concrete pits for conveyors, which were built in wet soil and quicksand, and though the sides were 3 ft. thick the pits were flooded by the percolation of water through the walls. Mr. Cummin (Long Island R. R.) pointed out that the cost per cu. yd. of concrete varies so greatly in different statements that it is evident care must be taken to analyze these, and to try and form some uniform basis of estimating the cost.

HAND AND AIR RIVETING.

The report presented the advantages of riveting by pneumatic hammers for the erection of new work, and for repair work; also the drilling of rivet holes for reinforcing old spans. An abstract of this was given in our issue of Oct. 18. There was no discussion.

CHEAPEST AND MOST PRACTICAL BUMPER FOR YARD TERMINALS.

Replies have been received from 24 members, representing 20 different roads. Of these 17 strongly recommend the Ellis bumper, 7 favorably mention a bumper composed of a heap of earth, 2 speak well of the Haley bumper, 2 like some form of frame bumper, 1 has a bumper of his own invention on much the same principle as the Ellis, 1 favorably mentions a pile bumper. One member believes that it is far better for all concerned to allow the superintendent's order to stand for bumpers. Your committee have used the Ellis, pile, and frame bumpers, and a heap of earth, and where it can be used without attracting unfavorable notice or occupying too much valuable room, we believe the latter is the ideal bumper. Where this cannot be used the Ellis is the best bumper, but this has some weak points. We condemn the use of spiral or rubber springs, as the former will break and the latter become useless with age; and we would gladly hail some form of bumper that could be used in all places, that did not have these weak points, and yet that was not too hard on the rolling stock; and, finally, that was in cost within the reach of all. B. F. Pickering, A. A. Page, W. E. Harwig, A. E. Killam.

Mr. Berg (Lehigh Valley R. R.) enquired as to the weak points of the Ellis bumper, as noted in the report. Mr. Pickering (Boston & Maine R. R.) explained that it was too rigid, so that it is liable to cause considerable injury to cars striking it heavily. The freight bumper has no springs, so that there is a dead blow when a car strikes it. The passenger bumper has a rubber spring or cushion, but this does not provide sufficient elasticity, and rubber soon becomes hard. He suggested the use of hydraulic recoil cylinders, as employed for heavy artillery. The Chicago, Rock Island & Pacific Ry. is using some concrete blocks for car bumpers, and they stand very well. Some are plain, and others have the track rails embedded in them, while others have the rails bent upward within the concrete. This latter arrangement is the least satisfactory, as the blocks have cracked under heavy shocks. No bumper will stop cars under all conditions, and in certain cases an order from the superintendent is the best bumper. Several members spoke of having had heavy bumpers broken or cars wrecked by trainmen as something to run cars against, instead of as a safety appliance to act only in case of emergency. Mr. Cummin (Long Island R. R.) used red flags at the end of tracks for several months during the reconstruction of a terminal, and not one was knocked over, because the men knew that the flags only marked the end of the track and would not stop a car sent too fast or too far.

TIE-PLATES ON BRIDGE TIES.

Practically all the members heard from agree that tie-plates are a benefit on soft wood ties, and several favor them on hard wood ties when the bridges are on curves or where the traffic is heavy. There was no discussion on this report.

After the reports had been read, and after the discussion on painting had been opened, the meeting adjourned.

The meeting on Wednesday was called to order at 9 a. m., and the first business was the reading of the committee appointed to prepare a history of the association. This was presented by Mr. J. H. Cummin (Long Island R. R.), and gave a review of the principal proceedings of the several annual meetings since the association was organized at St. Louis in June, 1891. The discussion of the reports of the previous year was then taken up, in accordance with the usual custom.

DISCUSSION OF REPORTS OF 1899.

(1) What is the Most Economical Method of Painting Railway Bridges and Buildings, and the Best Material to Use?—Two principal points brought out in this discussion were the extensive use of the pneumatic system of painting, and the generally unsatisfactory way in which iron work is cleaned before repainting. Mr. Pickering (Boston & Maine R. R.) remarked that painters do not like cleaning, and will not do it thoroughly unless carefully and constantly watched. Mr. Killam (Intercolonial Ry.) has a drawbridge over salt water on which the paint is in good condition after seven years' service. Where the spray strikes it, the paint is scaling; but by patching, the present coat will last for two years more. The paint was expensive in the first place, but has proved economical. Mr. Berg (Lehigh Valley R. R.) thought more care should be taken to ascertain the actual cost of work. Mr. McIntyre thought bridges should be painted more frequently, say every 2 to 4 years, as if rust is allowed to form and then scraped off the factor of safety of the bridge is gradually reduced. More time should be allowed, to ensure the cleaning and painting being properly done.

(2) Life of Different Kinds of Timber in Bridges of Various Kinds, and Advisability of Protecting Same from the Weather.—Mr. Pickering (B. & M. R. R.) considered that covering the trusses and chords of timber bridges added very considerably to their life, but another member questioned whether the results would warrant the cost except for large bridges. Several members using oak piles mentioned the life as from 4 to 14 years, owing undoubtedly to the varying qualities of timber used and the varying exposure. Chestnut piles last 20 to 30 years. Where tamarack piles are used they decay very rapidly in the end bents, covered by the bank, and it is found economy to use cedar for the three end bents. On the other hand, Mr. Pickering considered it doubtful if cedar piles are strong enough for rapid streams carrying much drift and ice. In ore docks and coal docks the life of the timbers is greatly reduced by covering them in such a way that there is no ventilation. Mr. Cummin (Long Island R. R.) had tried piles driven butt downward, but had to renew them in two years.

(3) The Best Method of Constructing and Maintaining Highway and Farm Crossings.—Mr. Walter G. Berg (Lehigh Valley R. R.) thought it important to adopt some other plan than that of planking the entire crossing. Mr. Cummin (Long Island R. R.) uses all plank (long-leaf yellow pine) for country roads, and iron guard rails with stone block paving in the streets of Brooklyn. The crossings are nominally under the charge of the general roadmaster, but for long diagonal crossings, or where electric railway tracks exist, the Bridge & Building Department is called upon. Another road uses oak planks on each side of each rail, with plank headers and slag filling. The maintenance is attended to by the section gangs. One member suggested pressed steel or malleable cast iron, which could be readily removed for tamping the ties.

(4) Best Practical Sanitary Arrangement for Local Stations Where There Are no Water or Sewer System.—Mr. Fort (Southern Ry.) uses road dust in the closets; other members spoke of using lime and ashes.

(5) Best and Most Economical Plant for Pumping Water for Water Stations.—In a brief discussion, the gas engine came in for a large share of approval, and next to that the air-lift system. One member having 15 steam plants and 2 gasoline plants in service, expects to introduce the latter as the former wear out. At one division point on the Buffalo, Rochester & Pittsburg R. R., compressed air from the shop plant is utilized for pumping.

(6) Prevention of Fire in Railway Buildings.—One member suggested that care was the best means of prevention. Stations are usualy equipped with hydrants and hose, and wooden trestles have water barrels at intervals. These barrels are filled by local freight trains.

(7) What Repairs Can Be Made, and How Can They Be Safely Made, to Metal and Wooden Spans Without the Use of Falseworks.—Mr. Manning promised to make a report on methods which he employs, and which he could not well describe in discussion. It was asked if this method was applicable where trains were passing every 10 or 15 minutes, to which Mr. Manning replied that by having all preparations carefully made a good deal can be accomplished in 10 minutes.

The committee on subjects then presented the following list of subjects to be reported on at the meeting of 1901: (1) Methods of Sinking Foundations of Bridge Piers in Water up to 20 ft. Deep; (2) Passenger Platforms at Way Stations; (3) Slips for Ferryboats Used for Transferring Railway Cars; (4) Best Method of Operating Turntables by Power; (5) Auxiliary Coaling Stations, Their Design, Capacity and Methods of Handling Coal; (6) Water Stations, Their Foundations, Tanks, Substructure, Connections and Capacity; (7) Is it Best for Railway Companies to Erect their Own Steel Structures, or to let the Manufacturers Erect Them; (8) Outfit Cars for Bridge Gangs, and Number of Men in Bridge Gangs. The meeting adjourned about noon.

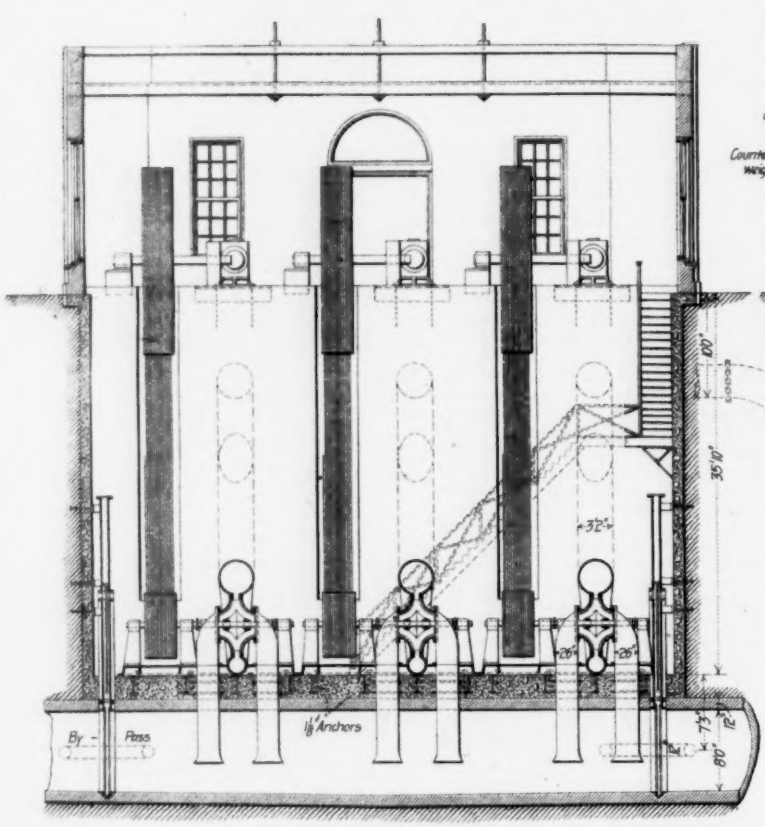
The afternoon session, from 2 to 6 p. m., was opened by the reading of a paper on "The Superintendent of Bridges and Buildings; His Duties and Responsibilities, by Mr. Onward Bates, M. Am. Soc. C. E., Engineer and Superintendent of Bridges and Buildings of the Chicago, Milwaukee & St. Paul Ry. Mr. Bates was not present. A short address was delivered by Prof. J. L. Van Ornum, of Washington University, St. Louis, and the committee on nominations presented its report. The remainder of the session was devoted to discussions of the reports read on the previous day, notes of which have already been given.

On Oct 18, after the party had been photographed in a group in front of the hotel, the meeting was called to order about 9:30 a. m. The auditing committee presented its report, showing a total balance in the hands of the Treasurer and Secretary to be $947. The committee on resolutions then presented a series of resolutions of thanks. A call for discussion on questions to be propounded by the members brought forth a short discussion on the filtration and chemical treatment of water at water stations, in the course of which Mr. A. S. Markley (C. & E. Ill. R. R.), explained that at Thebes, Mo., the water is treated chemically in one tank and then passes through a Jewell filter to a tank from which the railway hotel, boarding houses, shops, engines, etc., are supplied. There was also some further discussion on the question of bumpers. A vote on the place of meeting for 1900 resulted in the selection of Atlanta, Ga.

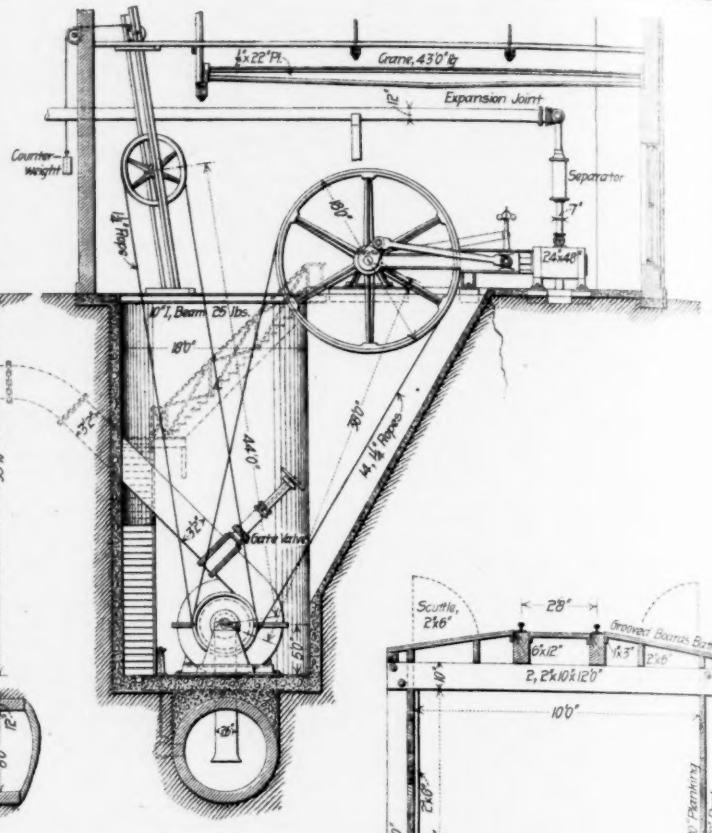
The election of officers resulted as follows: President, Walter A. Rogers (C., M. & St. P. Ry.); Vice-Presidents, W. S. Danes (Wabash R. R.), B. F. Pickering (Boston & Maine R. R.), A. Shane (Tol., St. L. & K. C. Ry.), and A. Zimmerman (Colo. & So. Ry.); Secretary, S F. Patterson (Boston & Maine R. R.); Treasurer, N. W. Thompson (P., Ft. W. & C. Ry.); Executive Committee, T. M. Strain (Wabash R. R.). H. D. Cleaveland (Pitts., Bess. & L. Erie R. R.), F. W. Tanner (Mo., Kan. & Tex. Ry.), A. Montzheimer (C. & N. W. Ry.), W. E. Smith (C., M. & St. P. Ry.), A. W. Merrick (C. & N. W. Ry.).

EXHIBITS AND ENTERTAINMENTS.

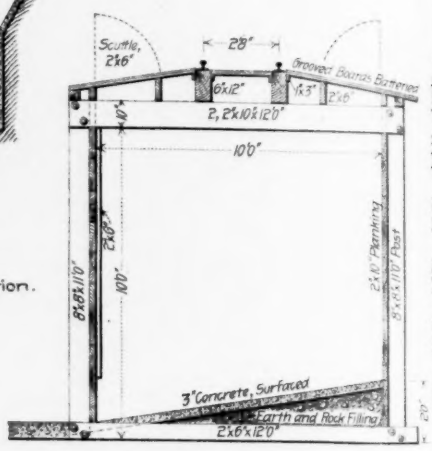
There were but few exhibits, and those were scattered in different parts of the hotel. Some particulars of these are given in our supplement. On Wednesday afternoon there was a coaching party for the ladies, visiting the parks, boulevards and handsome residence districts of the city. In the evening there was a theatre party for the members and their guests.



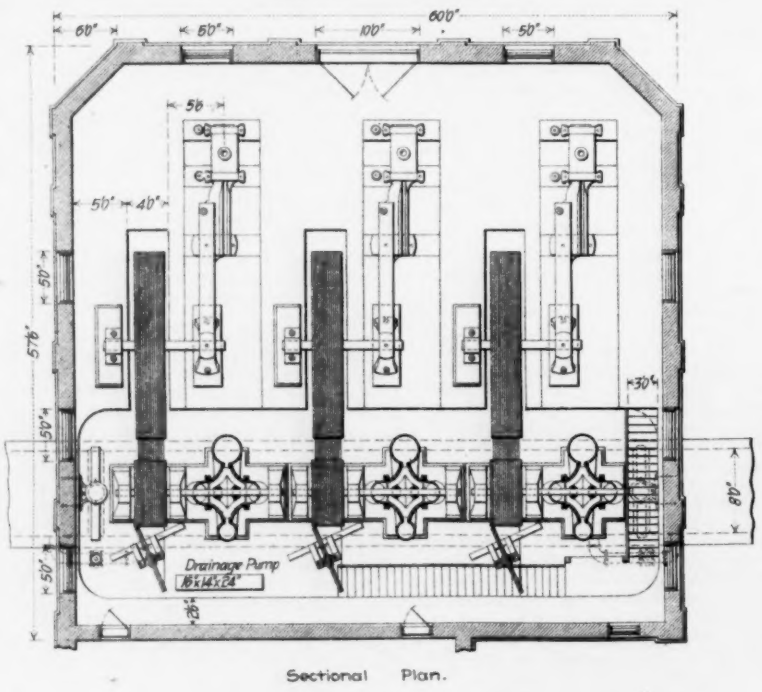
Longitudinal Section.



Transverse Section.



Cross Section.



Sectional Plan.

FIG. 8.
SECTIONS SHOWING ARRANGEMENT
OF PUMPING MACHINERY.

FIG. 7. DETAILS OF COAL BUNKER

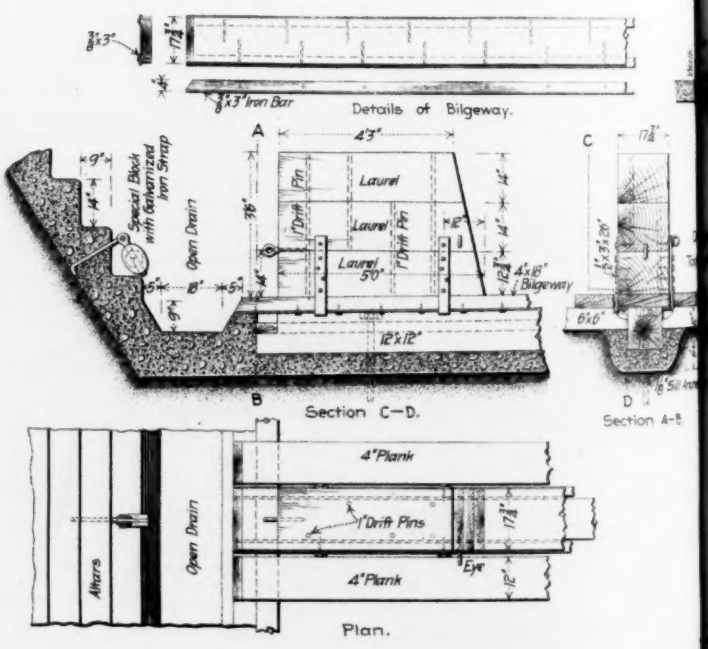
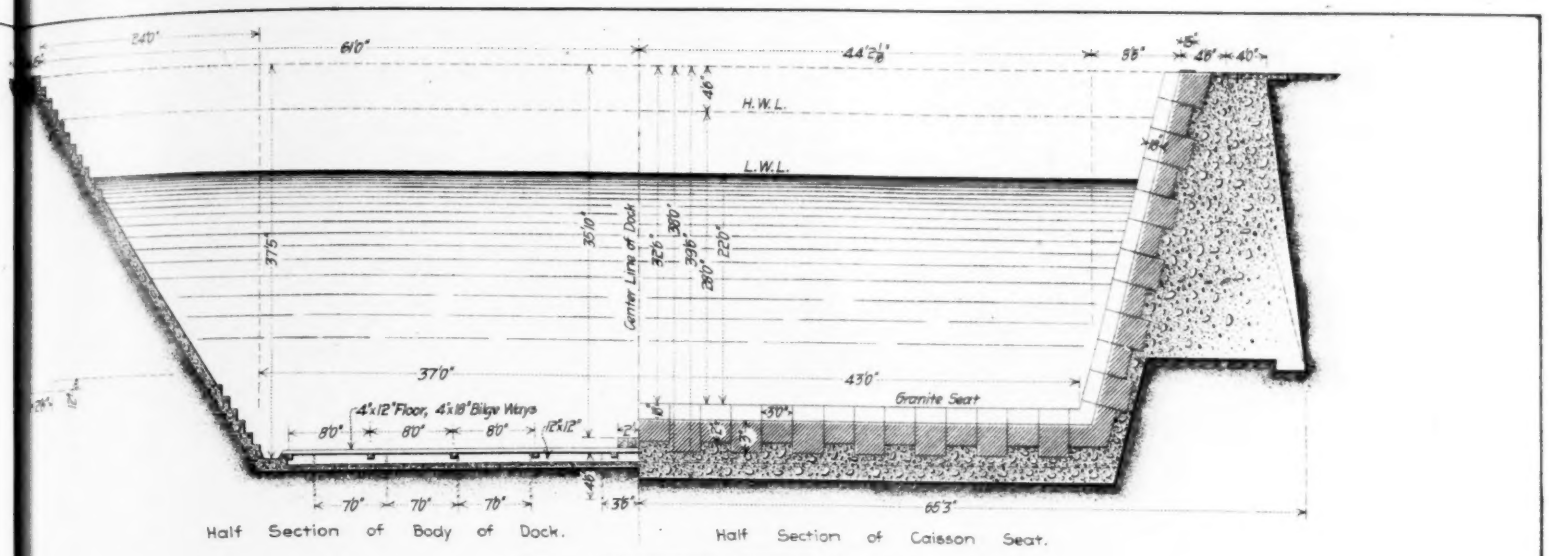


FIG. 3. DETAILS OF BILGE BLOCK, FLOOR AND ALTAR CONSTRUCTION.



Half Section of Body of Dock. Half Section of Caisson Seat.

FIG. 2. TRANSVERSE SECTIONS OF DOCK CHAMBER.

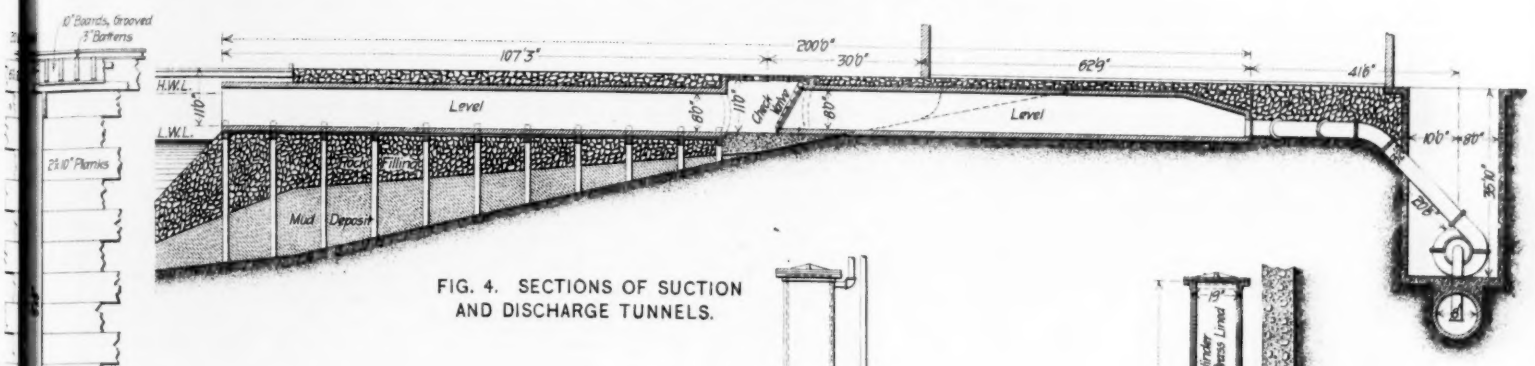


FIG. 4. SECTIONS OF SUCTION AND DISCHARGE TUNNELS.

FIG. 5. HYDRAULIC 8-FT. GATE VALVE FOR SUCTION TUNNEL.

750-FT. DRY DOCK
AT HUNTERS POINT,
SAN FRANCISCO,
CAL.

California Dry Dock Co.,
Owners.
Howard C. Holmes,
Engineer.

CHAS. HART, LITH., 95 VESEY ST., N. Y.